DOCUMENT RESUME

ED 339 889 CE 059 845

TITLE	Advanced Food Science and Nutrition Reference Book.
INSTITUTION	Texas Tech Univ., Lubbock. Home Economics Curriculum Center.
SPONS AGENCY	Texas Education Agency, Austin. Div. of Vocational Programs.
PUB DATE	Jul 91
NOTE	331p.; For the related curriculum guide, see ED 306 383.
AVAILABLE FROM	Home Economics Curriculum Center, Box 41161, Texas Tech University, Lubbock, TX 79409-1161.
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Behavioral Objectives; Classroom Techniques; *Cooking Instruction; *Course Content; Curriculum Guides; Food; *Food Processing Occupations; Food Service; *Foods Instruction; Home Economics Skills; Learning Activities; *Nutrition Instruction; Occupational Home Economics; Secondary Education; Teaching Methods; Test Items; Transparencies; Units of Study

ABSTRACT

Developed with input from personnel in the industries, this reference book complements the curriculum guide for a laboratory course on the significance of nutrition in food science. The reference book is organized into 25 chapters, each beginning with essential elements and objectives. Within the text, italicized, bold-faced vocabulary terms are included with definitions or explanations. Illustrations also are included, and chapter summaries and vocabulary sections are provided for each chapter. A review section and a critical thinking section also are included in each chapter, and an index of technical terms appears at the end of the book. The chapters cover these topics: economics and the world food supply; nutrition and health; special dietary needs; retaining nutrients in food; food additives; the world food supply; food and nutrition from an international perspective; scientific and creative aspects of food processing and marketing; safety and sanitation; methods for processing foods; the impact of food processing; quality of food products; forms of food products; manipulation of food products; cooking utensils; effects of temperature on food products; leavening agents; principles of protein, vitamin, and carbohydrate cookery; fat absorption in food preparation; making food products more nutritious; new forms and sources of foods; research in nutrition and food science; technology and food and nutrition; reliable nutrition information; and careers in nutrition and food science. There are 20 references. (KC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED339889

ADVANCED FOOD SCIENCE AND NUTRITION

REFERENCE BOOK

HOME ECONOMICS EDUCATION
TEXAS EDUCATION AGENCY
AUSTIN, TEXAS

CE 059 845

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it
☐ Minor changes have been made to improve reproduction quality

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

M Wragg

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

BEST COPY AVAILABLE

ADVANCED FOOD SCIENCE AND NUTRITION

Developed and disseminated by:

HOME ECONOMICS CURRICULUM CENTER
Box 41161, Texas Tech University
Lubbock, Texas 79409-1161

Directed by:
Texas Tech University
College of Home Economics
Lubbock, Texas

In Cooperation with:
Texas Education Agency
Department of Curriculum and Instruction
Division of Vocational Programs
Home Economics Education
Austin, Texas

JULY 1991

4

ACKNOWLEDGEMENTS

This *Advanced Food Science and Nutrition* reference book was prepared by the Home Economics Curriculum Center staff through funding from the Texas Education Agency, Austin, Texas, under Part B, Program Improvement, of Public Law 98-524, in cooperation with the College of Home Economics, Texas Tech University, Lubbock, Texas. The Division of Home Economics Education, Texas Education Agency, provides supervision and directional guidance for curriculum development.

The persons listed below made special contributions to the development of this publication.

Texas Education Agency Home Economics Education staff in Austin:

Judith A. Hetherly
Program Director

Virginia Chancellor
Occupational Education Specialist

Sharon Reddell Pierce
Occupational Education Specialist

Gay Nell McGinnis
Assistant Director

Cindy Gruner
Occupational Education Specialist

Tricia Hays, M.S. and Lynn Perrin, C.H.E. served as the writers for the *Advanced Food Science and Nutrition* reference book.

The following individuals served as advisors during the development of this publication:

Henria Bacon, Teacher
Home Economics Education
Ball High School
Galveston, Texas

Rita Crump, Supervisor
Home Economics Education
Mesquite Independent School District
Mesquite, Texas

Don Oatman
Ben E. Keith Company
Fort Worth, Texas

Dr. Nell Robinson
Professor and Chair
Department of Nutrition and Dietetics
Texas Christian University
Fort Worth, Texas

Dr. Sue Thompson
Program Director of Nutrition and Food
Southwest Texas State University
Department of Home Economics
San Marcos, Texas

Ivie Vernor, Teacher
Home Economics Education
Nueces Canyon High School
Barksdale, Texas

Dr. Al Wagner
Texas A&M University
Texas Agricultural Extension Service
College Station, Texas

Nina Wright, Teacher
Home Economics Education
Bryan High School
Bryan, Texas

Gwen Scharp, R.D.
Nutritionist
Texas Tech University Health Sciences Center
Lubbock, Texas

Bill Hopkins
Texas Education Agency
Division of General Education
Austin, Texas

The following individuals served as reviewers for the reference book:

Martha Dunlap
Corsicana High School
Corsicana, Texas

Lorelei Hollis
MacArthur High School
San Antonio, Texas

Kathy Hufstedler
Azle High Shool
Azle, Texas

Lana McRae
New Deal High School
New Deal, Texas

Jean Phipps
Sanderson High School
Sanderson, Texas

Sharon Rogers
Dobie High School
Houston, Texas

Carol Tatum
Princeton High School
McKinny, Texas

Home Economics Curriculum Center staff:

Betty Robinson
Director

Dawna Cowan
Editor

Shiretta Ownbey
Curriculum Specialist/Production
Supervisor

COMPLIANCE STATEMENT

TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION
Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action No. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

(1) acceptance policies on student transfers from other school districts;

(2) operation of school bus routes or runs on a nonsegregated basis;

(3) nondiscrimination in extracurricular activities and the use of school facilities;

(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;

(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;

(6) nondiscriminatory practices relating to the use of a student's first language; and

(7) evidence of published procedures for hearing complaints and grievances.

In addition to conducting reviews, the Texas Education Agency staff representatives check complaints of discrimination made by a citizen or citizens residing in a school district where it is alleged discriminatory practices have occurred or are occurring.

Where a violation of Title VI of the Civil Rights Act is found, the findings are reported to the Office for Civil Rights, Department of Health, Education, and Welfare.

If there is a direct violation of the Court Order in Civil Action No. 5281 that cannot be cleared through negotiation, the sanctions required by the Court Order are applied.

TITLE VII, CIVIL RIGHTS ACT OF 1964; EXECUTIVE ORDERS 11246 AND 11375; TITLE IX, 1973 EDUCATION AMENDMENTS; REHABILITATION ACT OF 1973 AS AMENDED; 1974 AMENDMENTS TO THE WAGE-HOUR LAW EXPANDING THE AGE DISCRIMINATION IN EMPLOYMENT ACT OF 1967; AND VIETNAM ERA VETERANS READJUSTMENT ASSISTANCE ACT OF 1972 AS AMENDED IN 1974

It is the policy of the Texas Education Agency to comply fully with the nondiscrimination provisions of all federal and state laws and regulations by assuring that no person shall be excluded from consideration for recruitment, selection, appointment, training, promotion, retention, or any other personnel action, or be denied any benefits or participation in any programs or activities which it operates on the grounds of race, religion, color, national origin, sex, handicap, age, or veteran status (except when age, sex, or handicap constitute a bona fide occupational qualification necessary to proper and efficient administration). The Texas Education Agency makes positive efforts to employ and advance in employment all protected groups.

TABLE OF CONTENTS

Acknowledgements iii

Compliance Statement v

Preface xii

Essential Elements xiii

Guide to Essential Elements xiv

Chapter 1 — Economics and the World Food Supply 1
The Food Chain 1
Food for the World 3
Food Prices and the Consumer 5
Government Agencies 6
Alternative Food Sources 7
Reducing Food Costs 8
Summary 10
Vocabulary 11
Review 11
Critical Thinking 12

Chapter 2 — Nutrition and Health 13
Nutrition and Disease 13
Nutrition and Aging 22
Summary 25
Vocabulary 25
Review 26
Critical Thinking 26

Chapter 3 — Special Dietary Needs 27
Reducing Sugar in the Diet 28
Functions of Dietary Fiber 29
Achieving Low-fat Diets 30
Sodium and Hypertension 31
Milk Allergies, Lactose Intolerance, and Milk Intolerance 32
Dietary Needs During Pregnancy 33
Summary 36
Vocabulary 37
Review 37
Critical Thinking 38

Chapter 4 — Retaining Nutrients in Food 39
Nutrient Loss in Food 39
Techniques that Preserve Nutrients 41
Summary 44
Vocabulary 44
Review 44
Critical Thinking 45

Chapter 5 — Food Additives 47
Food Additives 48
Food Additive Regulation 50
The Food and Drug Administration 53
Summary 55
Vocabulary 55
Review 56
Critical Thinking 56

Chapter 6 — The World Food Supply 57
Meeting the Nutritional Needs of the World 57
Technological Factors Affecting the Food Supply 60
Ecological Factors Affecting the Food Supply 62
Social Factors Affecting the Food Supply 63
Summary 66
Vocabulary 66
Review 67
Critical Thinking 67

Chapter 7 — Food and Nutrition from an International Perspective 69
International Organizations 70
Nutrition and World Progress 73
World Food Trade Policies 77
Summary 78
Vocabulary 78
Review 79
Critical Thinking 79

Chapter 8 — Scientific and Creative Aspects of Food Processing and Marketing 81
Technology in Food Processing and Marketing 81
Product Development 85
Creative Marketing Techniques 88
Summary 90
Vocabulary 90
Review 91
Critical Thinking 91

Chapter 9 — Safety and Sanitation 93
Contamination of Food 93
HACCP System 95
Quality Control 96
Summary 98

Vocabulary 98
Review 98
Critical Thinking 99

Chapter 10 — Methods for Processing Foods 101
Preservation Methods 102
Preparation Methods 107
The Role of Packaging in Food Processing 108
Summary 111
Vocabulary 111
Review 112
Critical Thinking 112

Chapter 11 — The Impact of Food Processing 113
Effects of Food Processing on Food Quality 113
Food in Space 116
Chemical Reactions During Food Processing 116
Summary 118
Vocabulary 118
Review 118
Critical Thinking 119

Chapter 12 — Quality of Food Products 121
United States Food Laws and Regulating Agencies 121
Food Standards of Content and Quality 126
Laboratory Evaluation Methods for Food Products 130
Summary 136
Vocabulary 137
Review 138
Critical Thinking 138

Chapter 13 — Forms of Food Products 139
Four Basic Forms 139
Food Product Evaluation 146
Summary 148
Vocabulary 148
Review 148
Critical Thinking 149

Chapter 14 — Manipulation of Food Products 151
Mixing and Kneading 151
Cutting 154
The Cooking Process 155
Summary 158
Vocabulary 158
Review 159
Critical Thinking 159

Chapter 15 — Cooking Utensils 161
Characteristics of Materials 161

Basic Utensils 164
Summary 169
Vocabulary 169
Review 170
Critical Thinking 171

Chapter 16 — Effects of Temperature on Food Products 173
Methods of Heating Food Products 174
Food Storage 177
Altitude and Food Cookery 181
Summary 183
Vocabulary 183
Review 184
Critical Thinking 184

Chapter 17 — Leavening Agents 187
Ingredients in Baked Goods 187
Forms of Leavening Agents 192
Summary 196
Vocabulary 196
Review 197
Critical Thinking 197

Chapter 18 — Principles of Protein, Vitamin, and Carbohydrate Cookery 199
Factors Affecting Protein Cookery 199
Factors Affecting Fruit and Vegetable Cookery 213
Factors Affecting Carbohydrate Cookery 215
Summary 221
Vocabulary 222
Review 223
Critical Thinking 224

Chapter 19 — Fat Absorption in Food Preparation 225
Classifications of Fats 226
Fats Used in Food Preparation 227
Fats and Frying Food 229
Summary 232
Vocabulary 232
Review 232
Critical Thinking 233

Chapter 20 — Making Food Products More Nutritious 235
Nutrification 236
Proteins 237
Carbohydrates 240
Vitamins and Minerals 243
Fats 245
Water 248
Summary 249

Vocabulary 250
Review 250
Critical Thinking 251

Chapter 21 — New Forms and Sources of Foods 253
Advances in Food Technology 253
Food Testing and Evaluation 257
Summary 260
Vocabulary 260
Review 261
Critical Thinking 261

Chapter 22 — Research in Nutrition and Food Science 263
Research Methods 264
Current Issues in Food Science Research 267
Summary 268
Vocabulary 268
Review 268
Critical Thinking 269

Chapter 23 — Technology and Food and Nutrition 271
Technology and Availability of Foods 271
Marketing and Market Research 274
World Food Distribution 278
Summary 284
Vocabulary 285
Review 285
Critical Thinking 286

Chapter 24 — Reliable Nutrition Information 287
United States Department of Agriculture 288
United States Department of Health and Human Services 292
Other Resources 293
Summary 296
Vocabulary 296
Review 297
Critical Thinking 297

Chapter 25 — Careers in Nutrition and Food Science 299
Careers in Food Science and Nutrition 300
Personal Characteristics 303
Entrepreneurship 306
Management Practices and Multiple Roles 308
Effective Money Management 310
Summary 312
Vocabulary 312
Review 313
Critical Thinking 313

References 315

Index 317

PREFACE

Advanced Food Science and Nutrition is a laboratory course that provides an in-depth study of the significance of nutrition in food science. It addresses the knowledge and skills needed to study food science, processing, marketing, and technology involved in food and nutrition. The opportunities in food and nutrition occupational areas are explored as well as the concepts and skills related to managing the dual roles of homemaker and wage earner.

Advanced Food Science and Nutrition reference book is one of the various reference books developed for use in Home Economics Education in Texas. The reference book is correlated closely with the Essential Elements prescribed by the State Board of Education in the Texas Administrative Codes for Vocational Home Economics. Additional curriculum materials are available for secondary education in the areas of Comprehensive and Technical Home Economics, Home Economics Cooperative Education, Home Economics Pre-employment Education, Home Economics Coordinated Vocational-Academic Education, and Home Economics Vocational Education for the Handicapped. Other curriculum materials are available for adult education and postsecondary education in home economics subject areas.

Components of the Instructional Materials

The *Advanced Food Science and Nutrition* series includes two publications: a reference book and a curriculum guide. The reference book and the curriculum guide are coordinated.

The *reference book* is organized into twenty-five chapters that are intended to be used as needed, not in any particular order. Each chapter begins with the Essential Element(s) and Objectives to Achieve. Within the text, italicized, bold-faced vocabulary terms are included with definitions or explanations. Illustrations also are included to aid student learning. The content of each chapter is summarized in the Summary section and vocabulary words are repeated in the Vocabulary section at the end of each chapter. A Review section and a Critical Thinking section also have been included to reinforce the basic content presented, aid in factual recall, and facilitate critical thinking skills. An index of technical terms and concepts is provided to facilitate use of the reference book.

The *curriculum guide* provides a variety of teacher information. Teaching strategies and teaching aids are coordinated with the chapters in the reference book. A variety of teaching strategies are included. The types of strategies include reading, lecture, discussion, audiovisuals, and activities. Transparency masters and handout masters are included for the teacher's convenience.

No one reference can provide all the information needed for a particular field. Therefore, students should be encouraged to study various topics more intensively, to use additional references, and to apply the information in either laboratory or on-the-job training. Hands-on experience is essential to understanding the concepts of food science and nutrition.

TAC 75.83
Advanced Food Science and Nutrition

(j) Advanced food science and nutrition (1/2 unit) shall be a laboratory-oriented course and include the following essential elements:

(1) Concepts and skills related to the significance of nutrition. The student shall be provided opportunities to:

(A) analyze the influence of economics on obtaining adequate nutrition;
(B) relate the role of nutrition to the prevention and treatment of health problems;
(C) plan diets to meet special dietary needs;
(D) summarize methods for retaining nutrients in foods;
(E) assess the safety factors of various intentional and incidental food additives;
(F) determine factors affecting the world food supply;
(G) describe international organizations contributing to improved nutrition; and
(H) relate nutrition to international trade, governmental relations, and world progress.

(2) Concepts and skills related to food processing and marketing. The student shall be provided opportunities to:

(A) summarize the scientific and creative aspects of food processing and marketing;
(B) outline safety and sanitation considerations for food processing and packaging;
(C) assess methods for processing foods;
(D) analyze the impact of processing on product quality, nutrition, and taste; and
(E) discuss chemical reactions that occur during food processing.

(3) Concepts and skills related to food science and food products. The student shall be provided opportunities to:

(A) evaluate the quality of food products for compliance with established standards;
(B) determine the effect of various forms of ingredients on food products;
(C) determine the effect of various manipulative procedures on the quality of selected food products;
(D) determine the effect of various cooking utensils on food products;
(E) determine the effect of various temperatures on food products;
(F) evaluate the effect of various leavening agents on food products;
(G) analyze principles of protein, vitamin, and carbohydrate cookery;
(H) analyze factors which affect fat absorption when frying foods; and
(I) determine methods for making food products more nutritious.

(4) Concepts and skills related to foods and nutrition technology. The student shall be provided opportunities to:

(A) evaluate new forms and sources of foods and food products;
(B) summarize major research in nutrition and food science;
(C) discuss the effect of technology on food and nutrition and food supply, marketing, and distribution; and
(D) propose ways to disseminate and use reliable nutrition information.

GUIDE TO ESSENTIAL ELEMENTS
Advanced Food Science and Nutrition
(TAC 75.83)

Advanced food science and nutrition (1/2 unit) shall be a laboratory-oriented course and include the following essential elements:

Required Essential Elements	Related Chapters
(j1A) Analyze the influence of economics on obtaining adequate nutrition.	1
(j1B) Relate the role of nutrition to the prevention and treatment of health problems.	2
(j1C) Plan diets to meet special dietary needs.	3
(j1D) Summarize methods for retaining nutrients in foods.	4
(j1E) Assess the safety factors of various intentional and incidental food additives.	5
(j1F) Determine factors affecting the world food supply.	6
(j1G) Describe international organizations contributing to improved nutrition.	7
(j1H) Relate nutrition to international trade, governmental relations, and world progress.	7
(j2A) Summarize the scientific and creative aspects of food processing and marketing.	8
(j2B) Outline safety and sanitation considerations for food processing and packaging.	9
(j2C) Assess methods for processing foods.	10
(j2D) Analyze the impact of processing on product quality, nutrition, and taste.	11
(j2E) Discuss chemical reactions that occur during food processing.	11
(j3A) Evaluate the quality of food products for compliance with established standards.	12
(j3B) Determine the effect of various forms of ingredients on food products.	13
(j3C) Determine the effect of various manipulative procedures on the quality of selected food products.	14
(j3D) Determine the effect of various cooking utensils on food products.	15
(j3E) Determine the effect of various temperatures on food products.	16
(j3F) Evaluate the effect of various leavening agents on food products.	17
(j3G) Analyze principles of protein, vitamin, and carbohydrate cookery.	18
(j3H) Analyze factors which affect fat absorption when frying foods.	19
(j3I) Determine methods for making food products more nutritious.	20

Required Essential Elements	Related Chapters
(j4A) Evaluate new forms and sources of foods and food products.	21
(j4B) Summarize major research in nutrition and food science.	22
(j4C) Discuss the effect of technology on food and nutrition and food supply, marketing, and distribution.	23
(j4D) Propose ways to disseminate and use reliable nutrition information.	24

1

Economics and the World Food Supply

ESSENTIAL ELEMENT

- ☐ Analyze the influence of economics on obtaining adequate nutrition.(j1A)

OBJECTIVES

- ☐ Analyze the economic factors that influence the food chain.
- ☐ Compare the differences between developed and developing countries' nutrition.
- ☐ Discuss factors that affect food prices.
- ☐ Review the responsibilities of the government agencies that regulate various aspects of the food industry.
- ☐ Identify alternative food sources.
- ☐ Describe methods of reducing food costs.

Food and nutrition has aroused interest since the time of primitive man. Prehistoric man had to hunt for wild plants and animals in order to have food. Agricultural skills and the domestication of animals provided a dependable food supply for early civilization.

All food originates from plant, fish, or animal sources. The ***origin of food*** can be linked to the location where the food is grown, developed, or manufactured. The natural environment is a key factor in food origins. The availability of water, type of land, and climate conditions affect the growth or development of food.

THE FOOD CHAIN

The ***food chain*** is the system in which matter and energy are transferred from organism to organism in the form of food. Plants make up the base of the food chain. Thus, they are known as the primary food source. Plants transform solar energy to food by a process called photosynthesis. The function of the food chain is to supply food to the organisms at all levels.

The food chain has five levels including the following:

1. Seeds are planted.
2. Plants grow.
3. Animals eat plants.
4. Man eats animals and plants.
5. Food supplies man with nourishment to plant more seeds.

Food chains often form what is known as a food web as a result of organisms eating more than one type of plant or animal. A ***food web*** is the linkage of organisms to one another by their dependence on each other for food. Figure 1.1 illustrates the food web.

Economics and the Food Chain

Food is a product of worldwide trade. The amount of food that can be produced is affected by economic, political, and technological factors. The food chain is important to the United States economy because the United States is considered a worldwide leader in food exports and in food production for consumption by its own citizens. Many countries in the world depend on the United States to supplement food supplies for their populations.

The types of food that make up food chains vary in different parts of the United States as well as in different parts of the world. Land, water, energy, and a desirable climate are all necessary for the successful function of the food chain. As a result of various climates and environments, different parts of the country produce different types of food. For example, wheat is produced in Kansas, and ocean-front cities supply fish and seafood products.

Food Web

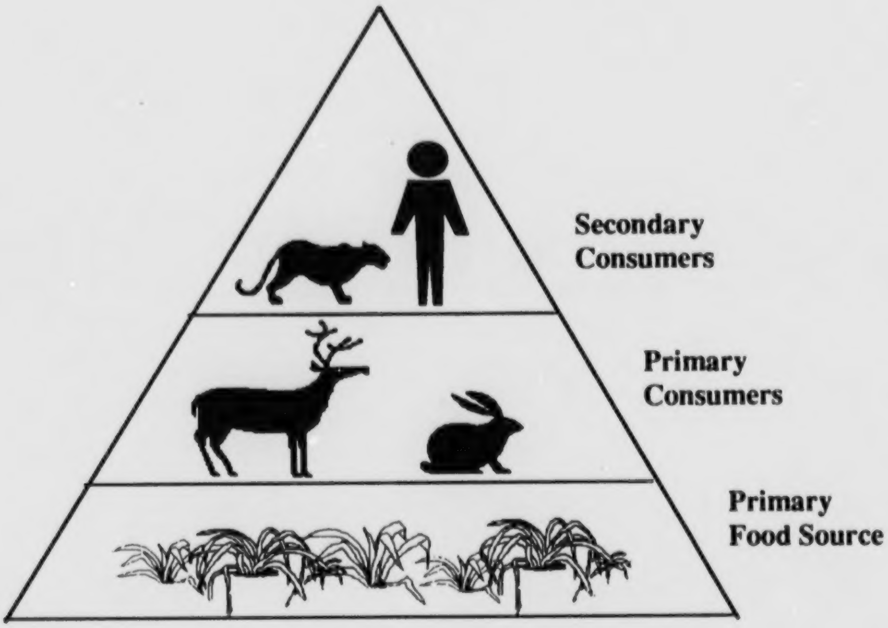


Figure 1.1

Harvesting losses and diseases, as well as the country's economic and political situation, are factors that influence the food chain. Drought or crop disease can cause a major interruption in the food chain. When the food chain is interrupted in the major food producing countries of the world, food availability and the nutritional well-being of the world population are affected.

It is important for governments and individuals to recognize that the food chain is fragile. In government controlled economies, the government dictates the amounts and kinds of foods that are produced. In countries with free economies, however, supply and demand as well as government subsidies and taxes control food production.

Individuals can help the world food situation by the choices they make that affect the food chain. By reducing the intake of processed foods, consumers conserve land, resources, and the energy needed to manufacture these foods.

One of the major factors affecting food chains is the costs involved in producing food at higher levels of the food chain. Included in these costs are fuel expenses, labor in production and processing, and technology in refining and manufacturing food products. The lowest costs of food production occur at the plant stage. When plants are consumed as food, the higher levels of refining, processing, and packaging are avoided. At each level of the food chain, more resources are needed to produce the food. Therefore, as the food selection moves to a higher level on the food chain, the cost of delivering that food to the consumer is increased.

FOOD FOR THE WORLD

Even though many differences exist in the diets of the global population, one factor is certain: all people need food for survival. Foods that are the dietary mainstays of the world population differ greatly among the developed and developing countries. ***Dietary mainstays*** are the foods that provide the main nourishment and are the most available in an area. ***Developed countries*** are those industrialized nations whose food production and supply can provide a sufficient standard of living for its citizens. Developed countries in our world include North America, Europe, USSR, Japan, Australia, and New Zealand.

The term ***developing countries*** includes those nations that are working to become more industrialized as well as those nations with severe economic problems. Africa, Asia, and Latin America are developing countries whose populations suffer from poverty, hunger, and malnutrition. At one time, the countries with an inadequate food supply were referred to as less developed countries. Now, the nations of the world are divided into two categories which are the developing and developed countries.

Grain is the dietary mainstay for many people in the world. Unrefined grain products, such as rice and corn, supply the main source of food energy for developing nations. Oats, rye, sorghum, and millet are grains that provide the basic nourishment in many countries. Potatoes and other home and farm grown vegetables are also part of the basic diet in developing countries. As nations become more industrialized, the dietary habits of the people change. A larger percentage of the diet is animal and highly processed foods, and a much smaller percentage is grain products. In developing countries, grain is consumed directly as cereals and grain products. The diets of people in developing countries who consume these products lack the nutritional balance they need for good health.

When the main source of nutrition is grain and grain products, the diet is deficient in energy, protein, and calcium. In developed nations, people consume grain indirectly. The animals eat grain and then the animals supply meat, milk, and eggs for people. When the dietary mainstay is animal products and highly processed foods, the diet tends to lack vitamin A, vitamin C, vitamin B_6, magnesium, zinc, and dietary fiber.

From Farm to Family

Whether from the farm, ranch, or sea, a chain of producers, processors, manufacturers, government regulators, and retailers work to provide consumers with the food products they need and desire.

The ***food system*** includes the steps a food item goes through until it reaches the supermarket shelf. Figure 1.2 illustrates the specific steps that a food item progresses through from the point of growing in the field until being served at a meal.

Steps in the Food System

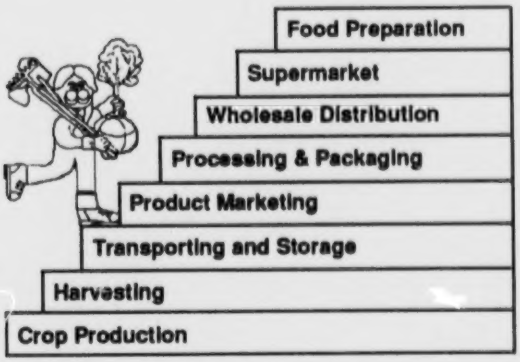


Figure 1.2

The business operations involved in the production, processing, and delivery of food to consumers is known as the ***food industry***. Figure 1.3 shows the process food goes through from the producer to the consumer. Consumers can be assured of safe, high-quality food products because of government standards the food industry must meet. The five main branches of the food industry are the following:

1. production
2. processing
3. packaging
4. transportation
5. marketing

From Producer to Consumer

Producer
↓
Processor
↓
Distributor
↓
Retailer
↓
Consumer

Figure 1.3

The food industry is a very complex system. As consumers demand more highly processed and specialty foods, the complexity of the food industry increases. During the last two decades, the growth of food technology has brought an increasing number of processed convenience foods to the supermarket shelf. ***Food technology*** is the science of adapting scientific methods directly or indirectly to food production, processing, and handling. Due to the increasing number of women in the work force and active lifestyles, the major emphasis in food technology is convenience. United States consumers are demanding quality food items that require a minimum amount of preparation at a reasonable cost. This demand also has increased the variety of imitation food products because of their lower costs.

All of these factors add to the complexity of the food industry. Each additional step in the food system increases the costs in terms of processing, energy usage, packaging, and labor. While people in developing countries seek basic foods to meet health and nutritional needs, citizens of developed countries continue to demand foods that are higher in the food chain.

The food system in the United States is more complex today than it was at the beginning of the twentieth century. Not only have food consumption patterns changed, but technological advances in food storage, food preservation, and food production methods have provided consumers with food products year round. The improved efficiency of the food transportation system also has added to the complexity of the food system. Fresh, refrigerated, and frozen foods are shipped across the United States and throughout the world.

Consumers in the United States are able to have the best food supply in the world for several reasons. The United States lies geographically in a temperate region. The ***temperate regions*** in the world are those that are located between the tropics and the polar areas. These regions provide soil and climate conditions that are excellent for farming. Also, most American farmers utilize proper production practices that allow them to produce large crops. In addition, the nation funds agricultural research that not only solves problems associated with agriculture, but also supplies farmers with up-to-date research information and development discoveries. The United States and the other developed countries have populations that grow more slowly than the food supply.

FOOD PRICES AND THE CONSUMER

As consumers in the United States enjoy a quality and variety of food the rest of the world does not know, the food industry continues to expand and improve the food supply. As marketing and production costs increase, so do food prices. However, Americans still pay less for food than any other country in the world. Only 12 to 14 percent of available income is spent on food.

Numerous factors affect food prices. These factors can be grouped into three areas including factors that affect production costs, factors that affect processing costs, and factors that affect marketing costs.

Production is the raising of crops and animals for food. The factors that affect production costs include farm expenses, crop size and quality, and weather conditions. ***Processing*** includes the cleaning, trimming, grinding, cooking, canning, freezing, baking, dehydrating, freeze-drying, and packaging of food. The costs for raw materials, packaging materials, labor, overhead, government regulations, and transportation and storage of food are included in the processing costs. ***Marketing*** refers to the costs of getting food to the consumer, such as advertising and selling. These costs are influenced by inflation, taxes, advertising costs, losses due to spoilage, shoplifting, and consumer demand.

Food prices are affected by supply and demand. ***Supply*** refers to the amount and availability of a food product. ***Demand*** refers to the consumer's desire to purchase a given item at a certain time. In the food industry as in other industries, the price of the product (food) is directly related to supply and demand. As the supply of a food product increases, the price decreases. On the other hand, if the supply is limited, the price increases. If the demand for a product rises, so does the price of that product. However, if the demand drops, the price drops.

A definite relationship exists between the price of food products and supply and demand. In the United States, farmers have often produced surpluses of grains and other major crops. The surplus of a food product lowers the consumer price because the demand is lessened. However, the lower prices reduce farm income so much that it forces the farmer out of business.

Foreign trade demands for United States food products increase the need for farmers to expand production. In the long term, these actions increase food costs for urban consumers. When farmers are encouraged to expand foreign markets, they increase production of crops. This results in expanded foreign sales which forces the prices of those products to go up. As Japan, Western Europe, and other developed nations demand increasing amounts of U.S. food products, prices the United States consumer pays will continue to rise.

GOVERNMENT AGENCIES

Government agencies are involved with the aspects of food that concern consumers. These agencies work to assure consumers of a safe food supply and to protect them against fraud in advertising and labeling.

The ***United States Department of Agriculture (USDA)*** is one of the largest departments of the federal government. This department supervises programs and services that involve farmers and consumers, such as food stamps for low-income families; farm price supports; loans to farmers; soil conservation; agricultural research; grading and inspection of meat, poultry, and eggs; crop forecasting and insurance; and foreign trade of agricultural products. The USDA is made up of approximately twenty agencies that administer these government programs and services.

The ***Food and Nutrition Service*** of the USDA directs the School Lunch Program, the Food Stamp Program, and the Food Distribution Program. All of these programs provide low-income families access to low-cost food. Another agency within the USDA is the ***Science and Education Administration***. This agency is involved in research, extension services, and teaching in areas of food and agricultural sciences. Many consumers depend on extension agents from the ***Cooperative Extension Service*** as resources for current information and assistance in agricultural production, home economics, and food and nutrition. The extension agents also work within communities to provide programs and services related to youth (4-H), community, and rural development. The Cooperative Extension Service serves rural and urban citizens.

The ***Federal Trade Commission (FTC)*** works to protect consumers from false or deceptive advertising. The FTC regulates the use of words in advertising that make health and curative claims. Claims are often made in advertising for products that are supposed to improve health or provide cures for people with diabetes, hypertension, obesity, high cholesterol, heart disease, or other health problems. The FTC investigates these forms of advertising and controls fraudulent sales promotions.

The ***Food and Drug Administration (FDA)*** is a branch of the United States Department of Health and Human Services. It was established in 1906. The major responsibilities of the FDA are to regulate and enforce standards of safety for the food, drug, and cosmetic industry. They also are responsible for controlling food labeling to protect consumers against fraud. The functions of the FDA include the following:
- Develop nutrition labeling regulations.
- Investigate and regulate the use of food additives.
- Establish standards of identity for certain

foods. ***Standards of identity*** specify the ingredients and amounts of ingredients that must be included in standardized foods.
- Define the use of the word "imitation" in identifying food products.
- Establish nutrition quality and fortification guidelines. Fortification is a process of increasing the nutrient value of a product by adding another ingredient to it, such as vitamins and minerals.
- Inspect food processing plants.
- Test products for pesticide residue, radioactive elements, toxic metals, and other undesirable elements.
- Publish warnings to the public if hazardous food products are found.

Many government programs influence the domestic food supply. Some of these government programs include farm subsidies, price supports, food embargoes, and federal feeding programs. Farm subsidies are monetary payments or other forms of aid that the federal government gives to farmers in order to control farm production and prices. This aid can be in the form of money, free land, tax relief, or legal rights. The federal government attempts to keep farm prices from falling below a certain level through price support programs. The government establishes minimum prices for key agricultural products and then purchases these products from farmers if the market price should fall below the established minimum level. The government then uses these food products for public aid and disaster relief programs.

Food embargoes are government orders that prohibit the movement of food products into or out of the country. In 1980, the United States restricted the sale of grain and other goods to the USSR in protest of the Soviet invasion of Afghanistan. During a U.S. food embargo, merchant ships carrying specific food or agricultural products are not allowed to enter or leave U.S. ports.

Federal feeding programs are projects and services that provide low-income families the opportunity to receive meals and food products free or at a reduced price. Included in the federal feeding programs are the National School Lunch and Breakfast Program, the Food Stamp Program, WIC (Women, Infants, and Children), Congregate Feeding Programs for senior citizens, and the commodity distribution program.

ALTERNATIVE FOOD SOURCES

If all the grocery stores, food retailers, restaurants, and fast-food chains closed their doors, consumers would search for ways to obtain adequate food for their families. Consumers should be knowledgeable about alternative food sources within the community.

Smart consumers make wise food selections by choosing foods that provide the most nutrition for the money spent. Alternative food sources other than the retail supermarket include farmers' markets, home gardening, roadside stands, and food cooperatives. These alternative food sources can provide the consumer with a variety of nutritious foods at lower prices.

Farmers' markets allow farmers to sell their produce directly to the consumer. Some communities have large open-air markets where local farmers can display their produce. The consumer can buy fresh, quality produce, but the consumer should be aware of the prices of the same items in the supermarket. At a farmers' market, the consumer has the advantage of bargaining with the farmer about the price. Some disadvantages to farmers' markets include the following:
- foods are only available when they are in season
- food products are not graded or inspected
- the variety of food is limited

Home gardening provides the consumer with an alternative to retail food buying. Home gardens can reduce family food costs, especially if large quantities are grown and preserved for the winter months. This provides many families with a year round supply of fruits and vegetables. The home gardener can plant a variety of fruits and vegetables. However, gardening involves work and the possibility of failure. Careful planning and regular attention to the home garden can greatly reduce the risk of failure.

During the growing seasons, roadside stands are found along highways in some farming communities. Roadside stands are much smaller than farmers' markets, because usually only one or two farmers have fresh produce to sell. Depending on the amount of consumer trade in the area, the prices can be considerably lower than those in the supermarket. Many consumers like to purchase produce from roadside stands because they can select garden fresh fruits and vegetables.

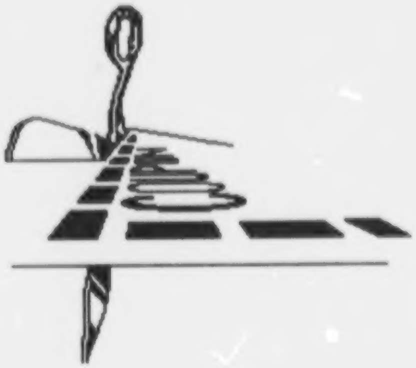
A ***food cooperative***, or co-op, is an organization of people (usually neighborhood residents) who buy food products in bulk at prices lower than the retail supermarket. The co-op buys the food wholesale and the members divide the purchases and share in the savings. Food cooperatives are effective only if they are well organized and well managed. The food selection is limited to those products that are the food choices of the majority of the members.

REDUCING FOOD COSTS

There are many ways consumers can reduce the cost of food for their families. Preparing food at home, rather than purchasing convenience food products, is one of the main ways to cut food costs. Examples of food preparation techniques that cut costs include making yogurt, granola, baby food, bread, and mixes at home.

Not all home prepared foods are less expensive than those prepared commercially. Some hidden costs in home prepared food items are the costs of time, energy, labor, containers, and equipment. There are also some disadvantages to preparing some foods at home. Homemakers who balance careers and family may not have the time and energy required to prepare many foods at home. Home prepared foods may have a shorter shelf life, the quality or taste may not be as acceptable as the commercially prepared item, and the cost may actually be higher. It is important to weigh all of these factors when comparing the costs of home prepared versus commercially prepared foods.

One method of controlling food costs and reducing food waste is learning ways to use foods wisely in meal preparation and planning meals carefully. Food costs may be reduced by using coupons and by taking advantage of weekly supermarket specials. Commercial food processors control costs and reduce waste through careful selection of crops, meat, fish, and poultry, and by exercising close control over food processing.



Many fruits and vegetables are damaged as the result of poor weather or growing conditions. A freeze or drought can damage an entire crop and make supplies of a particular item limited. This limited supply then causes the price to go up. A freeze in the orange grove may cause the damaged oranges to have to be made into orange juice. As a result, the prices of all orange products will increase.

Food processors and consumers have learned that it is not reasonable nor economical to destroy all damaged foods. Many food items that are overripe or stale are still completely safe to eat. Families can reduce food waste by learning how to use these foods wisely in meal preparation. Stale bread can be made into croutons, bread crumbs, stuffing, or toast. Overripe bananas can be used in cakes, quick breads, or milkshakes. Overripe tomatoes can be used in soups and stews.

It is important for food processors, food manufacturers, food distributors, food service establishments, and families to avoid food waste.

Summary

☐ All food originates from plant, fish, or animal sources. The origin of food can be linked to the location where the food is grown, developed, or manufactured.

☐ The system in which matter and energy are transferred from organism to organism in the form of food is known as the food chain. The function of the food chain is to supply food to organisms at all levels.

☐ A food web is the linkage of organisms to one another by their dependence on each other for food.

☐ Food is a product of worldwide trade. The amount of food that can be produced is affected by economic, political, and technological factors.

☐ The steps a food item goes through until it reaches the supermarket shelf is referred to as the food system.

☐ The business operations involved in the production, processing, and delivery of food to consumers is known as the food industry.

☐ The five main branches in the food industry include the following:
– production
– processing
– packaging
– transportation
– marketing

☐ Dietary mainstays are the foods that provide the main nourishment and are the most available in an area.

☐ Numerous factors affect food prices. These factors can be grouped into three areas: factors that affect production costs, factors that affect processing costs, and factors that affect marketing costs.

☐ The USDA, FDA, and FTC are government agencies involved with the aspects of food that concern consumers. These agencies work to assure consumers of a safe food supply and to protect them against fraud in advertising and labeling.

☐ Alternative food sources other than the retail supermarket include the farmers' markets, home gardening, roadside stands, and food cooperatives.

☐ Preparing foods at home, rather than purchasing convenience food products, is one of the main ways of cutting food costs.

Vocabulary

Cooperative Extension Service
demand
developed countries
developing countries
dietary mainstays
farmers' markets
federal feeding programs
Federal Trade Commission (FTC)
Food and Drug Administration (FDA)
Food and Nutrition Service
food chain
food cooperative
food embargoes
food industry
food system
food technology
food web
marketing
origin of food
processing
production
Science and Education Administration
standards of identity
supply
temperate regions
United States Department of Agriculture (USDA)

Review

1. Why is the natural environment a key factor in food origins?
2. What is the primary function of the food chain? List the levels of the food chain.
3. Why is the food chain important to the United States economy? What might cause the food chain to be interrupted?
4. What is the relationship of costs to the levels of the food chain?
5. What are the dietary mainstays of developed and developing countries? What characteristics differentiate developed and developing countries?
6. What are four factors that contribute to the complexity of the American food industry?
7. How are food prices affected by supply and demand? What other factors influence food prices?
8. Which government agencies are involved with the aspects of food that concern consumers?
9. What alternative food sources are available in your community? How can these alternative food sources reduce food costs for families?

10. What are ways families can reduce food costs?

11. What are the advantages and disadvantages of home prepared foods?

Critical Thinking

Assume you are an ambassador to the United Nations from one of the developing countries. What would be your country's greatest needs? What kinds of aid would you ask for from the developed nations? If your country was given food aid, what problems might you encounter in assuring that the food supplies reached the hungry citizens in your nation?

2

Nutrition and Health

ESSENTIAL ELEMENT

☐ Relate the role of nutrition to the prevention and treatment of health problems.(j1B)

OBJECTIVES

☐ Describe the relationship between nutrition and the common cold, nutrition and cancer, and nutrition and heart disease.

☐ Recall potential problems associated with the consumption of certain types of cholesterol.

☐ Identify various eating disorders and their symptoms.

☐ Summarize the social and psychological factors that affect the eating practices of the elderly.

Nutrition is the foundation for good health and the connection the body has to the food eaten. The statement, "You are what you eat," is certainly true from the standpoint of nutrition and good health. The study of nutrition is a science that involves the relationship of growth, development, and overall health to the intake of nutrients. People need to have basic knowledge of nutrition so they can separate fact from fallacy in health and nutrition claims.

The USDA's "Pattern for Daily Food Choices" illustrates the food guide presented in the Dietary Guidelines for Americans shown in figure 2.2. The "Pattern for Daily Food Choices" helps consumers use the guidelines by suggesting the number of servings to choose from each food group daily. It is shown in table 2.1. Suggestions for determining servings for various people are in figure 2.1.

NUTRITION AND DISEASE

Nutrition plays an important role in the prevention and treatment of certain diseases and health problems. The body's ability to resist disease is directly related to nutritional health.

A Pattern for Daily Food Choices

FOOD GROUP	SUGGESTED DAILY SERVINGS	WHAT COUNTS AS A SERVING?
Breads, Cereals, and Other Grain Products Whole-grain Enriched	**6 - 11** servings from entire group (Include several servings of whole-grain products daily.)	▲ 1 slice of bread ▲ 1/2 hamburger bun or english muffin ▲ a small roll, buscuit, or muffin ▲ 3 to 4 small or 2 large crackers ▲ 1/2 cup cooked cereal, rice, or pasta ▲ 1 ounce of ready-to-eat breakfast cereal
Fruits Citrus, melon, berries Other fruits	**2 - 4** servings from entire group	▲ a whole fruit such as a medium apple, banana, or orange ▲ a grapefruit half ▲ a melon wedge ▲ 3/4 cup of juice ▲ 1/2 cup of berries ▲ 1/2 cup cooked or canned fruit ▲ 1/4 cup dried fruit
Vegetables Dark-green leafy Deep-yellow Dry beans and peas (legumes) Starchy Other vegetables	**3 - 5** servings from entire group (Include all types regularly; use dark-green leafy vegetables and dry beans and peas several times a week.)	▲ 1/2 cup of cooked vegetables ▲ 1/2 cup of chopped raw vegetables, such as lettuce or spinach ▲ 1 cup of leafy raw vegetables, such as lettuce or spinach
Meat, Poultry, Fish, and Alternates (eggs, dry beans and peas, nuts, and seeds)	**2 - 3** servings from entire group	Amounts should total 5 to 7 ounces of cooked lean meat, poultry, or fish a day. Count 1 egg, 1/2 cup cooked beans, or 2 tablespoons peanut butter as 1 ounce of meat.
Milk, Cheese, and Yogurt	**2** servings from entire group (3 servings for women who are pregnant or breastfeeding and for teens; 4 servings for teens who are pregnant or breastfeeding)	▲ 1 cup of milk ▲ 8 ounces of yogurt ▲ 1 1/2 ounces of natural cheese ▲ 2 ounces of process cheese
Fats, Sweets, and Alcoholic Beverages	Avoid too many fats and sweets. Avoid alcoholic beverages.	

Adapted from: "Preparing Foods and Planning Menus," *Home and Garden Bulletin No. 232-8*, United States Department of Agriculture Human Nutrition Information Service, U.S. Government Printing Office: Washington, D.C., p. 11.

Table 2.1

Making the Menu Fit the Family

Nutrient and calorie needs vary from person to person, depending on age, sex, body size, and activity level. But even if your household contains people with different needs, you usually don't have to plan different menus for each person.

First, plan your daily menus to include at least the lower number of servings of foods from each group. Pick foods from all subgroups regularly. Then, adjust your menus for family members who need different amounts of food:

▲ Provide larger or smaller portions of menu items. For example, one-half cup cooked rice counts as one serving from the grains group; 1 cup of rice counts as two servings. A young child could have a smaller portion, about one-fourth to one-third cup.

▲ For those who need more servings, include additional foods in meals or snacks—a piece of fruit, a peanut butter sandwich, crackers and cheese, and so forth.

Here are some other tips for planning for different family members.

▲ *Toddlers and young children*

Serve young children the same variety of foods as everyone else, but in smaller amounts to suit their smaller needs. They should have the equivalent of 2 cups of milk each day, but you can serve it in three or four portions. Because small children often eat only a small amount at one time, offer them nutritious "meal foods" as snacks—milk or fruit juice, cut-up fruit, vegetable sticks, strips of cooked meat or poultry, whole-grain crackers and peanut butter, half a sandwich and so forth. To get enough calories to grow, many young children may need higher calorie foods such as whole milk.

▲ *Children*

Energy needs vary widely for elementary school children. They should eat at least the lower number of servings from each group. If they need more calories, increase the amount of food from the first five groups. Go easy on foods from the fats and sweets group.

▲ *Teenagers*

All teenagers need three servings of milk, cheese, or yogurt to meet their calcium needs. Teenage boys often need a lot of food. They can eat the higher number of servings from each food group. (With a moderate amount of fat and sugars, this supplies about 2,800 to 3,200 calories.) Some very active boys need even more. Encourage them to eat more foods from each of the first five food groups and to go easy on the sixth food group—foods high in fat and sugars.

Teenage girls usually need more food than the lower number of servings, especially when they are active or growing rapidly. They should increase their servings from the first five food groups. Teenage girls who are active participants in vigorous sports may need the higher number of servings or more. Encourage physical activity rather than repeated dieting to help control weight.

▲ *Adults of all ages*

Adults should have at least the lower number of servings from each food group. With a moderate amount of fat and sugars, this number of servings provides about 1,600 calories—about the right amount for a sedentary woman and some older adults. However, most adults will need more calories than this, depending on body size and physical activity. Most men can have the middle to upper number of servings in the ranges. The lower to middle numbers of servings in the ranges are more appropriate for most women. Regular exercise is important to maintain fitness. It also allows you to eat more food to supply the nutrients you need without gaining unwanted weight. Total food intake is most important in weight control, but increasing physical activity helps.

▲ *People with special needs*

Women who are pregnant or breastfeeding need to include at least three servings of milk, yogurt, or cheese to meet calcium needs. (Teenagers who are pregnant or breastfeeding should have four servings). They should eat more breads and cereals, fruits, vegetables, and meat and meat alternates, too. To meet higher needs for many vitamins and minerals during pregnancy, many physicians also prescribe a multivitamin and mineral supplement.

Toddlers, teenage girls, and women of childbearing age may not get all the iron they need from the amounts of food they eat. Be sure to include good sources of iron such as lean red meats, dry beans and peas, dark-green leafy vegetables, whole-grain and enriched breads, and iron-fortified breakfast cereals. Meat and the vitamin C in fruits and vegetables can help the body use the iron in iron-containing foods eaten at the same meal.

▲ *Older people*

Older people vary in their dietary needs. Many can eat like younger adults. Some elderly people eat relatively little food. They need to eat foods from each of the first five food groups, but they should eat less of foods in the sixth group—fats and oils, sugars and sweets, and alcoholic beverages. Elderly people or others who are on medication for treatment of chronic conditions may have vitamin and mineral supplements or special diets prescribed by their physicians. A dietitian can help you adjust your family menus to meet special dietary needs of these individuals.

Source: "Preparing Foods and Planning Menus," *Home and Garden Bulletin No. 232-8*, United States Department of Agriculture Human Nutrition Information Service, U.S. Government Printing Office: Washington, D.C., p. 10.

Figure 2.1

Nutrients found in food are essential for overall health and well-being. Although nutrients do not cure an illness as medicines do, the well-nourished body is better prepared to fight disease and keep itself healthy. ***Preventive nutrition*** is the process of maintaining good health and well-being through good nutrition practices before illness occurs.

The ***RDA*** is the Recommended Dietary Allowances for Americans. The RDA serves as a guideline for determining the amounts of nutrients a specific person needs each day. It gives the specific recommended daily nutrient needs for a person according to age and gender. The RDA is established by the National Food and Nutrition Board of the National Academy of Sciences. The ***U.S. RDA*** are the Recommended Daily Allowances developed by the Food and Drug Administration for use on food labels. The U.S. RDA is a standard that everyone can use to approximate daily nutrient needs.

Nutrition and the Common Cold

Many people believe that consuming large amounts of a certain food or taking large doses of vitamin supplements will cure an illness or disease. For many years, it has been rumored that consuming large doses of vitamin C (ascorbic acid) will prevent or cure the common cold. Scientific research indicates that large doses of vitamin C have no effect on the virus that causes colds.

Since vitamin C is a water-soluble vitamin, amounts above the body's daily need is excreted through the urine. However, it has been shown that megadoses of vitamin C above 2 grams can be harmful. Two grams of vitamin C are equivalent to 2,000 milligrams. The U.S. RDA for vitamin C is 60 milligrams. Therefore, a person who takes four 500 milligram vitamin C tablets is consuming three and one-half times the recommended amount. The person whose diet meets the minimum daily requirement of nutrients will most likely suffer less severely from colds, and the person will possibly recover sooner.

Nutrition and Cancer

Research has shown that diet and nutrition are related to cancer in several ways. It is evident that people's eating habits influence their susceptibility to certain kinds of cancer. However, there are many factors involved when considering the cause, prevention, and recovery from cancer. Besides diet and nutrition, genetic and environmental factors also are known to be involved. The challenge for researchers is to continually compare the dietary practices of those persons who get cancer with those who do not. One factor is clear, the risk of developing cancer may be greatly reduced in persons who make wise food choices and reduce or eliminate alcohol and tobacco consumption.

There are two categories of foods in relation to cancer. Foods that are known to promote cancer growth are in the first category. The second category contains those foods that are believed to prevent or retard the growth of cancer in the human body. Most recent studies show the relation of fat and fiber in the diet to the incidence of cancer in humans. Research has shown the direct relation of a low-fat, high-fiber diet to a reduced risk of breast, colon, and stomach cancers. *Nutrition and Your Health: Dietary Guidelines for Americans* are the guidelines issued by the U.S. Department of Agriculture and the U.S. Department of Health and Human Services in reference to nutrition, good health, and the prevention of disease. These guidelines are explained in figure 2.2.

Research on cancer risk and the diet suggests that people modify their food choices using these guidelines so as to reduce their risk of developing cancer. Choosing a wide variety of nutrient-rich foods as well as reducing fat intake and increasing intake of fiber-rich foods is a prescription for healthy eating.

Nutrition and Heart Disease

It is estimated that more than half of the people who die in the United States each year die of cardiovascular disease. ***Cardiovascular disease*** is a term that covers all the diseases of

Nutrition and Your Health:
DIETARY GUIDELINES FOR AMERICANS

1 **Eat a variety of foods.**
People need more than forty different nutrients for good health. Essential nutrients include vitamins, minerals, amino acids from protein, certain fatty acids from fat, and sources of calories (protein, carbohydrates, and fat). These nutrients should come from a variety of foods, not from a few highly fortified foods or supplements. Get the nutrients needed by choosing different foods you enjoy eating from five major food groups. These groups are vegetables, fruits, grain products, milk and milk products, and meats and meat alternatives.

2 **Maintain desirable weight.**
Being too fat or too thin increases chances of developing health problems. Being too fat is common in the United States. It is linked with high blood pressure, heart disease, stroke, the most common type of diabetes, certain cancers, and other types of illness.

3 **Choose a diet low in fat, saturated fat, and cholesterol.**
The higher levels of saturated fat and cholesterol in the diet are linked to increased risk for heart disease. A diet low in fat makes it easier to include the variety of foods you need for nutrients without exceeding your calorie needs because fat contains over twice the calories of an equal amount of carbohydrates or protein.

4 **Choose a diet with plenty of vegetables, fruits, and grain products.**
Vegetables, fruits, and grain products are important parts of a varied diet discussed in the first guideline. They are emphasized in this guideline especially for their complex carbohydrates, dietary fiber, and other food components linked to good health.

5 **Use sugars only in moderation.**
Sugars and many foods that contain them in large amounts supply calories but are limited in nutrients. Thus, they should be used in moderation by most healthy people and sparingly by people with low calorie needs. The more often these foods—even in small amounts—are eaten the greater the risk for tooth decay.

6 **Use salt and sodium only in moderation.**
Table salt contains sodium and chloride--both are essential in the diet. However, most Americans eat more salt and sodium than they need. In the United States, about one in three adults has high blood pressure. If these people restrict their salt and sodium, usually their blood pressure will fall.

7 **Avoid alcoholic beverages.**
Drinking alcoholic beverages is illegal in Texas for people under age 21. Heavy drinking of alcoholic beverages is related to malnutrition, liver disease, and some forms of cancer. Drinking alcoholic beverages during pregnancy can damage the developing fetus. People who drink alcoholic beverages before driving increase their risk of car accidents.

Sources: U.S. Department of Agriculture and U.S. Department of Health and Human Services *Home and Garden Bulletin* No. 232., "Nutrition and Your Health: Dietary Guidelines for Americans, " Third edition, 1990.
U.S. Department of Agriculture and Human Nutrition Information Service, *Dietary Guidelines and Your Diet: Home Economics Teacher's Guide*, February 1988.

Figure 2.2

the heart and blood vessels. Most of these deaths can be attributed to atherosclerosis. ***Atherosclerosis*** is a hardening of the arteries characterized by a thickening of the artery walls with plaques. ***Plaques*** are mounds of lipid matter that accumulate on the inner walls of the arteries. ***Lipid*** is a term used to describe fats, oils, and fat-related substances. Atherosclerosis leads to the closing or blocking of the arteries that supply blood to the heart and brain. Obstruction or blockage in the arteries can cause heart attacks and strokes.

Most people have some plaques in their arteries. The important factor is how advanced the buildup is and what can be done to slow down its progression. Certain factors have been identified as risk factors in relation to atherosclerosis. These factors include the following:

- **Smoking.** Smoking is considered one of the causes of heart disease. Smoking reduces the level of HDL cholesterol; HDL is the good cholesterol.
- **Gender.** Males are more prone to heart disease than females.
- **Heredity.** Persons with a family history of heart disease and diabetes have a greater risk.
- **High blood pressure.** Also known as hypertension, high blood pressure is a major risk factor in heart disease and strokes.
- **Lack of exercise.** Regular exercise helps control weight, reduces stress, and improve circulation.
- **Obesity.** Obesity causes increased stress on the heart and other organs and increased levels of serum cholesterol.
- **Stress.** There appears to be some link between a person's personality, reaction to stress, and heart disease.
- **High blood cholesterol level.** Blood cholesterol levels that are over 200 milligrams per 100 milliliters of blood are considered high.
- **Personality characteristics.** Type A behavior. Type A personalities are most generally competitive, resist fatigue, tense, and withhold emotions.

By identifying and controlling the risk factors that are present in one's life, a person can slow the progression of atherosclerosis. Good nutrition, along with the other factors, plays an important role in preventing heart disease. Research has shown that it is a combination of the risk factors, rather than just any one in particular, that makes some persons more susceptible to heart disease than others. There are certain dietary goals that prove to be beneficial in lowering blood cholesterol levels. These dietary goals for lowering blood cholesterol are described in figure 2.3.

Dietary Goals for Lowering Blood Cholesterol Levels

1. Reduce total fat intake to 30 percent of total calories.
2. Include more whole grains in the daily diet.
3. Eat fish more often.
4. Increase consumption of fiber-rich fruits and vegetables.
5. Add the many varieties of legumes to the daily diet more often, such as dried beans and peas and soybeans.
6. Include nonfat or low-fat milk and milk products every day.
7. Reduce the cholesterol-rich foods in the diet, especially organ meats, egg yolks, shellfish, and fatty red meats.

Figure 2.3

Along with the dietary goals for reducing the risk of coronary heart disease, other lifestyle changes also reduce the risk. These are identified in figure 2.4.

Lifestyle Changes that Reduce the Risk of Heart Disease

- **Stop smoking.**
- **Reduce blood pressure through diet or medication.**
- **Reduce body weight if needed.**
- **Increase exercise and activity.**
- **Reduce stress and enjoy life.**

Figure 2.4

Americans are striving to become a healthier population. More people than ever before are taking an interest in their nutritional and overall health and well-being. Hopefully, this will lead to a drastic reduction in the number of deaths from cardiovascular disease.

Cholesterol. In recent years, cholesterol has received much media attention and has become a household word. ***Cholesterol*** is an odorless, soft, fatlike substance found in every cell in the body. Cholesterol performs several functions in the body. These include the following:

- to aid in digestion
- to contribute to the structure and function of cell membranes
- to assist in the manufacture of vitamin D (calciferol) and hormones

It is not necessary to eat foods containing cholesterol because the liver makes most of the cholesterol that the body needs. Even though cholesterol is found in every cell in the body and is necessary for its function, it also makes up the main part of the plaques that block the arteries in atherosclerosis.

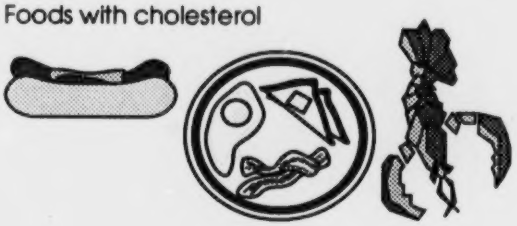
Cholesterol travels through the bloodstream in lipoproteins. ***Lipoproteins*** are lipids combined with proteins that transport lipids in the blood. There are two types of lipoproteins that transport cholesterol throughout the body. The two types are:

- low-density lipoprotein (LDL)
- high-density lipoprotein (HDL)

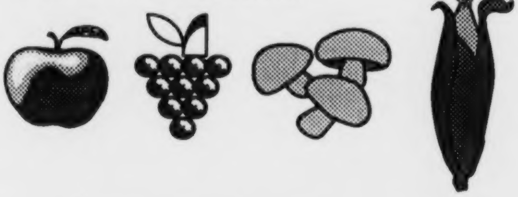
Low-density lipoproteins (LDL) carry cholesterol from the liver throughout the body but do not return the cholesterol to the liver. Therefore, cholesterol remains in the arteries and can cause a buildup in the artery walls. ***High-density lipoproteins (HDL)*** clear excess cholesterol from the arteries and carry it back to the liver where it is processed and removed from the body. LDL is often called "bad" because of its inability to remove cholesterol from the bloodstream. HDL is often called "good" because of its ability to prevent cholesterol and fat deposit buildup in the artery walls. It is this buildup of cholesterol plaques that contributes to advanced atherosclerosis.

Cholesterol is found only in foods of animal origin. Foods high in cholesterol are egg yolks, liver, organ meats, shellfish, lard from animals, and butter. Foods that contain no cholesterol or are low in cholesterol include egg whites, fruits, vegetables, and grains and grain products. One of the major factors in blood cholesterol levels is the dietary intake of fats—particularly saturated fats.

Foods with cholesterol



Foods without cholesterol



Fats are semisolid, energy-filled organic compounds found in animal and plant tissues. The major form of fat in the body and in foods is known as triglycerides. ***Triglycerides*** are chemical compounds that contain carbon, hydrogen, and oxygen. Fats are classified as saturated, monounsaturated, or polyunsaturated. ***Saturated fats*** have the most hydrogen. Saturated fats are found in butter, chocolate, egg yolks, lard, and many other foods. ***Monounsaturated fats*** have less hydrogen than saturated fats, and ***polyunsaturated fats*** have the least amount of hydrogen. Some examples of monounsaturated fats include some cooking oils, olive oil, some peanut butter, and some salad dressings. Polyunsaturated fats are found in such foods as Brazil nuts, some cooking oils, peanut butter, soft margarine, and walnuts. The more saturated the fat, the more solid it is at room temperature. The American Heart Association has issued guidelines for "heart healthy" eating. These are shown in figure 2.5.

American Heart Association Diet Guidelines

To control the amount and kind of fat you eat:

- Limit your intake of meat, seafood and poultry to no more than 6 ounces per day.
- Use chicken or turkey (without skin) or fish in most of your main meals.
- Choose lean cuts of meat, trim all the fat you can see, and throw away the fat that cooks out of the meat.
- Substitute meatless or "low-meat" main dishes for regular entrees.
- Use no more than a total of 5-8 teaspoons of fats and oils per day for cooking, baking and salads.

To control your intake of cholesterol-rich foods:

- Use no more than three egg yolks a week, including those used in cooking.
- Limit your use of shrimp, lobster, and organ meats.

The American Heart Association recommends this diet for all healthy Americans over the age of two. Ask your doctor for specific advice before making major eating pattern changes in young children. Consult your doctor or nutritionist about the nutritional needs of children and teenagers during growth periods, and get advice about the special nutritional needs of women who are pregnant or breast-feeding.

Reproduced with permission.
©"The American Heart Association Diet: An Eating Plan for Healthy Americans," 1986
Copyright American Heart Association

Figure 2.5

As research concerning the relationship of diet and coronary heart disease continues, people must stay informed of the latest findings, and in the meantime, take a rational approach to modifying their diet. The recommendations from the health professionals seem to be that persons who do not suffer from any particular health problem should choose a healthful diet by eating a variety of foods in moderate amounts that supply their daily nutrient requirements. This practice will ensure a lifetime of healthy eating.

Eating Disorders

Eating disorders, primarily anorexia nervosa and bulimia, are diseases that are characterized by a preoccupation with weight loss and thinness. These disorders can have damaging effects on the physical and mental health of the persons plagued by them.

Anorexia Nervosa. In an affluent society where food is plentiful, an illness known as anorexia nervosa affects almost one out of every 100 young women. Prior to 1950, this disease was almost unheard of. But in affluent developed nations, anorexia nervosa has almost become an epidemic. ***Anorexia nervosa*** is an eating disorder characterized by an obsessive and compelling desire to be thin. Out of every twenty young people with this disorder, nineteen of them are female. This disorder resembles an addiction because the person becomes totally obsessed with weight loss and a lifestyle of self-prescribed starvation takes over. This self-imposed starvation slowly begins to affect the person's personality and ability to think rationally. Many times this obsession with thinness causes the person to resort to excessive exercise in combination with the starvation. This can result in serious bodily injury because the body has not been supplied with the energy and nutrients needed. Physical symptoms of anorexia nervosa are shown in figure 2.6. One of the symptoms of anorexia nervosa is anemia. ***Anemia*** is a condition in which the blood cannot transport oxygen to the cells in the body. This is caused by a shortage of red blood cells or the presence of abnormal red blood cells. Anemia is often a result of nutritional deficiencies and other diseases.

Physical Symptoms of Anorexia Nervosa

- Deterioration of the body; especially muscle tissue
- Menstruation stops in females; impotency occurs in males
- Skin assumes dry, yellowish tint
- Low blood pressure
- Heart function becomes inefficient due to the effect of starvation on hormones that regulate blood pressure
- Excessive hair growth on the body (possibly for warmth)
- Touching causes painful sensations
- Anemia
- Interrupted sleep patterns; bad dreams

Figure 2.6

The treatment for anorexia nervosa is threefold. First, it involves medical personnel in the diagnosis and treatment of the medical complications that arise from prolonged starvation. Second, the treatment involves psychiatric or psychological personnel in treating the self-defeating behaviors that reinforce severe eating disorders like anorexia nervosa and bulimia. Third, the dietitian provides nutrition counseling for the patient to help with weight gain and the return to normal eating patterns.

Bulimia. Bulimia is another eating disorder that has plagued our affluent society since it was first recognized as a medical disorder in 1980. It is similar to anorexia in that it seems to strike mostly young women who have an obsession with an unrealistic perfect body. Some characteristics of people with bulimia include the following:

- They participate in binge eating followed by purging. Purging is an attempt to remove food from the body either by self-induced vomiting or the continual use of laxatives.
- They are successful and desire perfection.
- They turn to food in a crisis.
- They have a history of dieting and weight gain during the teen years.
- They binge and purge secretly.

Bulimia is an eating disorder characterized by self-induced vomiting following binge eating. ***Binge eating*** is the overindulgence of food without control or rational judgment about the amount being consumed. Sometimes a person with bulimia uses laxatives to rid his or her body of what is thought to be harmful. These binge eating periods are not in response to hunger, but rather a compelling need by the person with bulimia to rid his or her body of food that might cause weight gain. Bulimic behavior is sometimes brought on by family stress or feelings of rejection. Characteristics of a person with bulimia are low self-esteem, social anxiety, depression, isolation, and difficulty with interpersonal relationships. Figure 2.7 lists the dangerous effects of bulimia.

Damaging Effects of Bulimia

- irritation of the esophagus
- abnormal heart rhythms
- injury to the kidneys
- bladder and kidney infections, possibly causing kidney failure
- lacerations or tears to the stomach, caused by excessive vomiting
- tooth decay
- malnutrition

Figure 2.7

The treatment for bulimia is similar to that of anorexia nervosa because it involves the assistance of medical, psychological, and dietetic personnel. Through nutrition counseling, psychotherapy, and medical therapy, the bulimic patient can regain a new sense of self-worth and learn ways to control the need for binge eating. However, our society must change its attitude toward the unrealistic images of perfect people with perfect bodies that are expressed through the media. It is imperative that positive messages of respect and value for each individual's unique qualities and talents replace those negative messages currently seen by the young people of the affluent nations. Ideally, this type of societal change would greatly reduce the number of victims of anorexia nervosa and bulimia.

NUTRITION AND AGING

Aging is a natural process that is designed into the genes at conception. It occurs as a normal progression of the life cycle. Nutritional needs change during the various stages of the life cycle. Table 2.2 lists the stages and nutritional requirements of the various stages of the life cycle.

It is important to understand the nutritional needs during the various stages of the life cycle. This section deals with the nutritional needs of the elderly and the implications their nutritional needs have on their overall health and well-being.

Special Nutrition Requirements During the Stages of the Life Cycle

Life Cycle Stage	Nutrition Requirements
Pregnancy (includes nursing mothers)	Approximately 300 additional calories are required each day for increased energy needs. Weight gain should average between 24 to 28 pounds during pregnancy. A well-balanced, nutritious diet is important because of the increased need for protein, vitamins, and minerals. The diet should include more milk products and more fruits and vegetables.
Infancy (Birth through 1 year)	Most of the infant's nutritional needs during the first year are met through human milk or infant formula. Formulas contain amounts of protein, vitamins, and minerals recommended by the American Academy of Pediatrics. Some formulas are iron-fortified. It is not recommended that solid foods be given to infants until four to six months of age.
Early Childhood (2 years through 5 years)	Childhood obesity and iron-deficiency anemia are the two nutritional problems most commonly diagnosed during childhood. Children should be fed nutritious foods at every meal. Breakfast is especially important, and nutritious snacks help meet the child's daily nutrient needs. Iron-fortified breakfast cereals and lean meat help supply daily iron requirements.
Middle Childhood (6 years through 12 years)	Children should be encouraged to eat a variety of nutritious foods at mealtime and snack time in order to meet their daily nutritional needs for growth and development. Children of this age can learn to choose healthy foods. Snack foods may need to be monitored at this time because consumption of sugary foods and empty calorie foods increases during this stage.

Table 2.2

Adolescence (13 years through 20 years)	Rapid growth periods occur in girls between the ages of 10 and 13 years, and in boys between the ages of 12 and 15 years. Consumption of well-balanced, nutritional meals is important during these years. An increased need for calcium occurs due to rapid bone growth. Teens need to increase their intake of foods from the milk group. Poor food choices during adolescence lead to calcium deficiency, iron-deficiency anemia, and excessive intake of saturated fats, sugar, and empty calorie foods.
Young Adulthood (21 years through 40 years)	It is important for young adults to realize that the food choices, health practices, and lifestyle decisions made in the young adult years have significant effect on health and wellness in later life. Eating a well-balanced diet and exercising on a regular basis are good beginnings for young adults. Iron and calcium intakes are very important.
Middle Adulthood (41 years through 65 years)	Adults in this stage need to follow the guidelines for good health and disease prevention. These guidelines recommend that people should eat a variety of foods, maintain desirable weight, avoid too much fat, saturated fat, and cholesterol, increase intake of foods with sufficient starch and fiber, avoid eating too much sugar and sodium, exercise regularly, refrain from smoking and consuming alcohol, and try to limit undo stress.
Older Adulthood (over 65 years)	A healthy diet can help reduce some of the effects of aging. Poor nutritional health at this stage can affect the severity of disease, as well as affect mental function. Some guidelines for nutritional health for older adults include four to six small meals eaten frequently, sufficient intake of vitamins B_6, B_{12}, thiamin, C, D, E, and the minerals calcium iron, and zinc is important. Regular exercise is needed to stimulate appetite and food intake. Weight loss can increase risk of death following illness or disease.

Table 2.2—Continued

Due to increased health awareness and advances in medical science, Americans are living longer than ever before. It is anticipated that by the year 2050, the percentage of the population age eighty-five years and older will increase to more than 5 percent of the total U.S. population. There is certainly a need for more nutrition education and guidance for this segment of the population and their families.

The older adult population varies from those who maintain healthy, independent lifestyles to those who are suffering from disabling illnesses and require institutional care. Certainly those who are ill have special nutritional needs, but those who live independently also have different nutritional needs than they did in their younger years. Helping older adults develop healthy eating practices that meet their daily energy and nutrient needs can improve their general health, energy levels, and self-esteem, and it may reduce the risk of other health problems in the future.

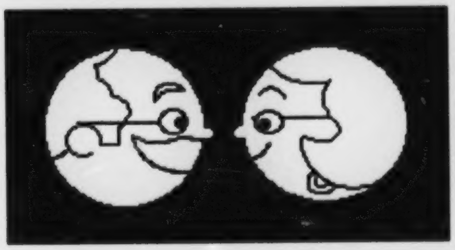
Numerous social and psychological factors affect the eating practices of the elderly. Many senior adults must adjust to being alone after the death of a spouse with whom they had shared fifty or sixty years. This new adjustment brings about loneliness, despair, and a lack of motivation to prepare and eat nutritious meals. Senior citizens also may face financial difficulties and/or physical disabilities. Persons who have reached this stage of the life cycle without establishing a regular routine of exercise may suffer from loss of appetite due to lack of physical activity.

Diets of elderly adults may contain too many carbohydrates and not enough fruits, vegetables, meats, and dairy products. Foods such as breads, crackers, sweet rolls, cereals, and cookies may make up a large portion of their diet. Older adults seem to prefer these foods because they are less expensive, do not require refrigeration or preparation, and are easier to chew than meats, fruits, and vegetables.

This high carbohydrate diet indicates that senior adults' diets may be lacking in several important nutrients. Figure 2.8 lists some possible nutrient needs of elderly adults. People with illnesses and other health problems may have different dietary needs.

Several government and community programs provide balanced meals for senior citizens. The ***Meals on Wheels*** program enlists volunteers to deliver hot meals to senior adults who are ill, handicapped, or just unable to cook for themselves. ***Congregate Feeding Programs*** at Senior Citizen Centers provide nutritious hot meals every day as well as a social gathering place for these older adults. It is believed that the social and psychological impact of eating alone and cooking for one are the major factors affecting malnutrition in many older adults. Family members can help by planning special outings and family meals that include the older adults in their family. Activities that allow the elderly to interact with others help to eliminate some of the loneliness and help to motivate them to take better care of their health.

Nutritional Needs of Older Adults



Older adults may need to increase intake of the following:

- ↑ **Protein** is an essential part of all living cells; it is used for energy if needed.
- ↑ **Iron** helps prevent anemia.
- ↑ **Calcium** helps prevent adult bone loss (osteoporosis).
- ↑ **Vitamin A (retinol)** prevents night blindness; increases defense against bladder, lung, and skin cancers.
- ↑ **Vitamin C (ascorbic acid)** helps produce and maintain collagen (foundation of connective tissues), helps prevent infections, and aids in absorption of iron and calcium.
- ↑ **Folate** is important for growth of new cells, protein metabolism, and formation of red blood cells.
- ↑ **Fiber** aids in the prevention of constipation, appendicitis, diverticulosis, colon cancer, atherosclerosis, and hemorrhoids.

Older adults may need to decrease intake of:

- ↓ **High-fat diets** are associated with an increased risk of arthritis, cancer of the breast and colon, gallbladder disease, heart disease, and obesity.
- ↓ **Sugar** is associated with tooth decay and obesity.
- ↓ **Sodium** is associated with fluid retention and high blood pressure.

Figure 2.8

Summary

- The study of nutrition is a science that involves the relationship of growth, development, and overall health to the intake of nutrients.
- The person whose diet meets the minimum daily requirement of nutrients will most likely suffer less severely from colds and possibly recover sooner.
- The risk of developing cancer may be greatly reduced in persons who make wise food choices and reduce or eliminate alcohol and tobacco consumption.
- By identifying and controlling the risk factors that are present in one's life, a person can slow the progression of atherosclerosis.
- Even though cholesterol is found in every cell in the body and is necessary for its function, it is also the main part of the plaques that block the arteries in atherosclerosis.
- Anorexia nervosa and bulimia are serious eating disorders that require medical, psychological, and nutritional counseling and treatment.
- Helping older adults develop healthy eating practices that meet their daily energy and nutrient needs can improve their general health and energy levels and self-esteem, and it may reduce the risk of other health problems.
- Diets of elderly adults seem to contain too many carbohydrates and not enough fruits, vegetables, meats, and dairy products.
- Activities that allow the elderly to interact with others help to eliminate some of the loneliness and help to motivate them to take better care of their health.

Vocabulary

anemia
anorexia nervosa
atherosclerosis
binge eating
bulimia
cardiovascular disease
cholesterol
Congregate Feeding Programs
fats
high-density lipoproteins
lipid
lipoproteins
low-density lipoproteins
Meals on Wheels
monounsaturated fats
plaques
polyunsaturated fats
preventive nutrition
RDA
saturated fats
triglycerides
U.S. RDA

Review

1. What is the study of nutrition?
2. How is resistance to disease related to nutrition?
3. Does vitamin C (ascorbic acid) cure the common cold? Why?
4. What are the seven Dietary Guidelines for Americans?
5. How is diet related to atherosclerosis?
6. What are the seven dietary goals for lowering blood cholesterol?
7. What is cholesterol? What is its function in the body?
8. What is the difference between HDL and LDL in relation to blood cholesterol levels?
9. What is anorexia nervosa? How is it treated?
10. What is bulimia? What are four damaging effects of bulimia?
11. How can society work to reduce the incidence of anorexia and bulimia?
12. What social and psychological factors affect the eating practices of the elderly?
13. Why do older adults typically chose a high-carbohydrate diet?
14. How can families help to improve the nutritional health of elderly family members?
15. Describe two community nutrition programs that provide hot meals for the elderly.

Critical Thinking

Brainstorm and list nutritional needs of adolescents living 100 years ago and of teenagers living today. Consider differences in lifestyles, growth and development, food choices, and stress factors. Compare the differences in the nutritional needs of adolescents from both generations. Evaluate the changes that have occurred in society which have affected the nutritional and health needs of adolescents.

3

Special Dietary Needs

ESSENTIAL ELEMENT

☐ Plan diets to meet special dietary needs.(j1C)

OBJECTIVES

☐ List strategies for reducing the amount of sugar in the diet.

☐ Describe the functions of dietary fiber in the body.

☐ Discuss ways to achieve a low-fat diet.

☐ Explain the relationship of high intakes of sodium to hypertension.

☐ Distinguish between milk allergies, lactose intolerance, and milk intolerance.

☐ Evaluate dietary needs of women during pregnancy.

In the last decade, the American population has taken a serious look at health and health issues. The relationship between lifestyles, daily diets, and health and fitness has become a topic of conversation and confusion for many people. Media attention to all types of special diets has even caused alarm for many people. It is necessary to understand the health problems that require people to greatly modify their diets. Information related to low-salt, low-sugar, and low-fat diets is important for all consumers to know and understand.

Advances in medical science have shown an increasing relationship between the food consumed and good health. Doctors and dietitians also know the many ways diet is related to disease and recovery. Recently, diet and health information has centered on preventive measures that might reduce a person's risk of certain illnesses such as heart disease, diabetes, or cancer.

REDUCING SUGAR IN THE DIET

The average American consumes an estimated sixty to eighty pounds of sugar a year. That is approximately one-fourth pound of sugar per day. One reason for this high intake of sugar could be the amount of hidden sugar found in convenience food items not normally thought of as sweets.

Carbohydrates are nutrients that supply energy for body functions. The other energy sources are proteins and fats. Carbohydrates are broken down in the body into sugars, starches, and fiber. The sugars are known as ***simple carbohydrates*** and the starches and fibers are known as ***complex carbohydrates***. Fiber is used to aid the digestion of food. Sugars and starches are broken down in the body into the simple sugar glucose. ***Glucose*** is the major sugar found in the bloodstream and supplies energy for the body. Some body tissues, such as red blood cells and parts of the brain, are able to get energy only from glucose.

Several carbohydrates are broken down into glucose during digestion. These terms are often used on food labels in place of the word *sugar*. Figure 3.1 lists the most commonly used terms.

Sugar Terms Used on Food Labels

sucrose—white refined table sugar, brown sugar, confectioner's sugar
fructose—the most concentrated sweetener (found in fruits); small amounts provide the same sweetening as larger amounts of other sugars
maltose—malt sugar; found in breads and cereals
lactose—milk sugar; found in milk and milk products
glucose—honey, corn syrup

Figure 3.1

Food labels also may have other terms for sugar. Some of the other words for sugars that are used on food labels include the following:

- brown sugar
- confectioner's sugar
- corn sweeteners
- syrup
- dextrose
- granulated sugar
- high-fructose corn sweeteners
- honey
- invert sugar (glucose and fructose)
- maple sugar
- molasses
- natural sweetener
- raw sugar

The Dietary Guidelines for Americans discussed in Chapter Two suggest that people increase their intake of complex carbohydrates and decrease their intake of simple carbohydrates. Currently, it is estimated that the typical American consumes 25 percent of calories from simple sugar and 25 percent from complex carbohydrates. It is recommended that people reduce their sugar intake to only 10 percent of total calories and increase their complex carbohydrate intake to 50 percent of all calories. Diets low in pure sugar and high in complex carbohydrates are generally lower in fat and calories and higher in fiber than diets that contain a large percentage of pure or refined sugars.

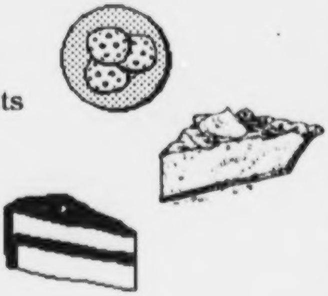
All forms of sugars, as well as all digestible carbohydrates, have four calories per gram. High-sugar foods have often been linked to health problems such as diabetes, obesity, heart disease, and tooth decay. ***Diabetes*** is a genetic disorder and is not caused by eating too much sugar. Diabetes occurs in an individual whose pancreas does not produce enough insulin to control blood sugar levels. Diabetics must control their intake of carbohydrates in order to maintain normal blood sugar levels. There is no evidence that a high-sugar diet causes heart disease. The relationship to heart disease occurs because persons with high-sugar diets are often overweight. Obesity is a risk factor for heart disease. Too much sugar in the diet is a factor for tooth decay. Sugary foods create a perfect climate in the mouth for the growth of the bacteria that destroys tooth enamel and causes tooth decay.

Figure 3.2 lists foods that contain simple carbohydrates and those that are classified as complex carbohydrate foods. Foods from the complex carbohydrate list should be chosen as sources of energy and for their valuable vitamins and minerals.

Simple and Complex Carbohydrate Foods

Simple Carbohydrate Foods

cakes
candies
cookies
dried fruits
jams
jellies
pastries
sugars
syrups



Complex Carbohydrate Foods

breads
cereal grains
crackers
fresh fruits
fresh vegetables
honey
legumes
pasta

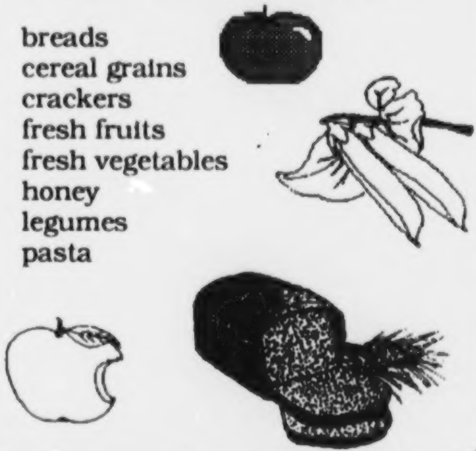


Figure 3.2

Consumers must learn to identify sugar in their diets. Strategies for reducing the amount of sugar in the diet include the following:

- Select pure fruit juices rather than soft drinks or imitation fruit drinks.
- Choose unsweetened cereals rather than the presweetened varieties. Learn to read the labels for sugar content.
- Eat fruits canned in natural juices rather than in heavy syrups.
- Reduce intake of "empty calorie" foods. Empty calorie foods contain calories but no nutritional value, such as soft drinks.
- Select fresh fruits for snacks. The sugar content of dried fruits is much higher.
- Try using the sweet spices—allspice, cardamom, cinnamon, cloves, coriander, ginger, and nutmeg—to replace some of the sugar in recipes.

FUNCTIONS OF DIETARY FIBER

Fiber has been one of the new "health words" since the early 60s. However, very few people really understand the role fiber plays in nutrition and health. ***Fiber*** comes from the contents of plants that the human body cannot digest.

There are many types of fiber. Fiber is classified into two categories: soluble and insoluble. Soluble fiber is dissolved in water and may help control diabetes and lower blood cholesterol levels in some people. Soluble fiber is found in some fruits, beans, and oat bran. Insoluble fiber is not able to be dissolved in water and therefore has different functions from soluble fiber. Insoluble fiber helps move food through the digestive tract. It aids in the prevention of colon and rectal cancer, helps to control diverticulosis, and helps prevent constipation. ***Diverticulosis*** is caused when bulging pockets form on the intestinal wall and can become inflamed. Sources of insoluble fiber are fruits, vegetables, wheat bran, whole wheat, and some beans.

Fiber has many functions in the body. Some of these functions that help prevent medical problems include the following:

- Fiber keeps contents of the intestines moving and prevents constipation.
- It helps reduce the risk of colon cancer by allowing food to pass quickly through the digestive tract. This limits susceptibility to agents in foods that might cause cancer.
- Fiber stimulates muscles of the digestive track. Well-toned digestive track muscles aid in prevention of diverticulosis and hemorrhoids.
- Fiber absorbs water and gives a feeling of fullness. This helps people feel full longer and thus contributes to healthy eating and weight control.

ACHIEVING LOW-FAT DIETS

Many Americans are selecting low-fat diets in an attempt to reduce their risk of coronary heart disease and cancer. ***Fats*** are lipids that are in a solid state at room temperature. ***Oils*** are lipids that are in a liquid state at room temperature. ***Lipid*** is the scientific term that includes all of the fats, fat-related substances, and oils. Fat is one of the essential nutrients and performs several functions in the body. Fats are a source of the essential fatty acids. ***Linoleic acid*** is one of the essential fatty acids and is found in polyunsaturated fat substances. It is important for clotting blood and lowering blood pressure. Linoleic acid is the only fatty acid that the body does not make. It must be consumed in plant foods such as corn, safflower, or soybean oils. Fats are also needed to transport the fat-soluble vitamins A, D, E, and K throughout the body. Without the presence of fat, these vitamins would not be utilized.

Fats also serve as an energy source. At nine calories per gram, fats supply twice as much energy as carbohydrates and proteins. It is not necessary to consume a fat-rich diet because the body makes fat from excess carbohydrates and proteins not used for energy. However, diets containing excessive amounts of fat can lead to health risks.

Health professionals believe that the average American diet contains too much fat. Although there is no RDA for fat, it is recommended that fat intake be limited to 30 percent of the daily diet. Figure 3.3 gives the formula for figuring the percent of fat in the diet.

Figuring the Percent of Fat in the Diet

Number of grams of fat
x 9 calories per gram
Total number of calories from fat

Total number of calories from fat	+	Total number of calories daily	=	Percent of calories from fat

Example: An adolescent who eats 2,000 calories per day could figure the percent of his or her diet that was from fat if 80 grams of fat was consumed.

80 grams of fat
x 9 calories per gram
720 calories from fat

720 calories from fat	+	2,000 calories per day	=	36% calories from fat

Figure 3.3

Some commonly eaten foods may have a higher fat content than many consumers realize. For example, amounts of fat in common foods include the following:

- Hamburger—approximately 35 grams
- Club sandwich—approximately 30 grams
- Fried onion rings—approximately 23 grams
- Beef burrito—approximately 21 grams

These are approximate amounts. The exact fat content would vary depending on the serving size and method of preparation.

As discussed in Chapter Two, high-fat diets lead to elevated blood cholesterol levels. People with abnormally high blood cholesterol levels are in a high-risk group for advanced atherosclerosis.

In order to maintain a normal blood cholesterol level, people should reduce their intake of saturated fats. In order to achieve a low-fat diet, it is important to follow a few simple guidelines:

- Read labels to learn the fat content of foods.
- Choose to bake, broil, braise, or steam foods; eliminate frying. (These cooking methods are discussed in Chapter Sixteen.)
- Refrigerate soups and stews before serving. Skim off hardened fat.
- Reduce intake of high-fat desserts.
- Reduce consumption of bacon, sausage, and luncheon meats.
- Use herbs, spices, and lemon juice to season and flavor foods.
- Choose canned fish products packed in water.
- Try using low-fat, low-calorie salad dressings.
- Use nonstick sprays in frying pans before sautéing.
- Choose low-fat or fat-free menu items and snack foods.
- Skin poultry and trim visible fat from lean meats.
- Use vegetable protein sources such as lentils, dried beans, and peas.
- Use low-fat and nonfat dairy products.
- Reduce consumption of foods high in saturated fat.
- Choose polyunsaturated fats when possible.
- Reduce total dietary fat intake.

It is helpful to know which foods contain saturated fats and which foods contain polyunsaturated fats. Figure 3.4 lists foods high in saturated fats and foods high in polyunsaturated fats. Remember that saturated fats are those that have the most hydrogen. Polyunsaturated fats have the least amount of hydrogen.

Foods High in Saturated Fat

- Beef, pork, or lamb
- Butter and lard
- Tropical oils (coconut, palm, and palm kernel)
- Sour cream, ice cream, whole milk products
- High-fat cheeses
- Bacon, some luncheon meats
- Cakes, pastries

Foods High in Polyunsaturated Fat

- Vegetable oils—corn, safflower, soybean, cottonseed, sunflower
- Nuts—peanuts, pecans, cashews, walnuts
- Soft margarines and spreads

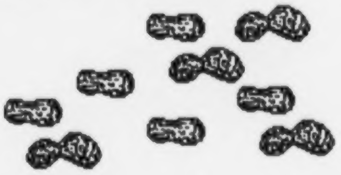


Figure 3.4

SODIUM AND HYPERTENSION

Sodium and potassium are minerals that function in the body as electrolytes. ***Electrolytes*** affect the way fluid is distributed in the body and aid the nervous system in transmitting nerve impulses that control muscle action. This is very important in keeping the heart beating normally. Sodium also helps the kidneys to maintain a normal acid/alkali balance in the body.

There is no minimum daily requirement or RDA for sodium because the American diet shows no evidence of shortage of this mineral.

In fact, the opposite is more likely true. A large portion of the population has elevated sodium levels. Excessive consumption of sodium can result in hypertension. ***Hypertension***, or high blood pressure, means that the heart must work much harder to pump the blood. High blood pressure can be hereditary, a result of obesity, or a result of too much salt in the diet.

Due to the increased incidence of hypertension in adults, health professionals recommend that persons without health problems limit their sodium intake to two grams per day. This would amount to approximately 2,000 milligrams per day. Table 3.1 lists commonly eaten foods that are high in sodium.

MILK ALLERGIES, LACTOSE INTOLERANCE, AND MILK INTOLERANCE

Many people cannot drink milk or consume milk products because of milk allergy, lactose intolerance, or milk intolerance. ***Milk allergy*** is caused by an allergy to the protein in raw milk. Milk allergy occurs when a person has a reaction after drinking raw milk. Usually these people can consume milk in other forms or can drink boiled milk. Boiling milk denatures the protein and therefore prevents the allergic reaction. People with milk allergy can usually successfully consume milk cooked into foods or

Foods High in Sodium

Food	Amount	Sodium Content (mg)
Crackers, saltine	4	165
Bacon	3 slices	303
Catsup	2 Tbsp.	312
Salt	1 tsp.	315
Worcestershire sauce	1 Tbsp.	315
Cheese, processed	1 oz.	406
Frankfurter (beef and pork)	1	504
Salad dressing, Ranch	1/2 c.	522
Peanuts, salted	1 c.	626
Pizza, cheese	1 slice	699
Luncheon meat	2 pieces	810
Cottage cheese, small curd	1 c.	850
Soup, canned tomato	1 c.	872
Pickles, dill	1 whole	928
Olives, green	10	936
Burrito, bean	1	1030
Ham, lean	3 oz.	1128
Cheeseburger	4 oz. patty	1224
Chicken patty sandwich	1	1252
Corn dog	1	1252
Enchilada	1	1332
Smoked Salmon	3 oz.	1700

Source: "Nutritive Value of Foods," *Home and Garden Bulletin No. 72*, United States Department of Agriculture, Revised April 1981.

Table 3.1

other calcium sources. Most cases of milk allergy occur in children.

One of the most prevalent of milk induced illness in children and adults is lactose intolerance. ***Lactose intolerance*** is the body's inability to digest the milk sugar known as lactose. The enzyme lactase aids the body in digesting lactose. ***Lactase*** is the digestive enzyme that breaks down lactose so that it may be digested and absorbed. When the body does not produce lactase, the lactose cannot be digested and illness occurs. Persons suffering from lactose intolerance must select other calcium-rich foods in order to meet their daily nutrient requirement for calcium. The addition of the enzyme lactase to milk can help people with lactose intolerance. The enzyme lactase can be purchased in a form that can be added to the milk, or enzyme-treated milk can be purchased in the supermarket dairy case.

Milk intolerance is a condition or illness following consumption of milk or milk products. The cause of milk intolerance is not known, except that it is not due to milk allergy or lactose intolerance. Most people who suffer from milk intolerance must experiment with various foods to determine which they can eat.

Calcium is one of the most important nutrients. It is one of the major minerals and is stored in the bones. It is essential for bone growth and the prevention of bone loss in adulthood. Calcium is also necessary for the transmission of nerve impulses and muscle performance, such as the heartbeat. For many years, people believed that only children needed to drink milk while the body was building bones and muscles. However, research has shown that it is just as important for adults to consume calcium-rich foods in order to prevent bone loss. A condition known as ***osteoporosis*** occurs when there has been a calcium deficiency and bone loss over a period of years. Osteoporosis causes weak, brittle bones and a deterioration of the skeleton.

Physicians and dietitians may recommend substitute food items to replace the calcium-rich milk and milk products in the diet. It is important to choose nutrient dense items as substitutes because milk and milk products supply an abundance of other essential nutrients besides calcium. People with these problems must experiment with different foods to find those that can be tolerated. The following are some alternative foods to substitute for the milk products in the diet:

- boiled milk
- calcium-fortified soy milk
- cheese
- cottage cheese
- enzyme-treated milk (milk with the enzyme lactase)
- goat's milk
- imitation milk (not considered suitable for infants and children)
- supplements
- yogurt

As a last resort, a physician may have to prescribe calcium supplements for a patient. Calcium is not absorbed as well from a pill as it is from food. Also, pill supplements do not offer the variety of nutrients that are available from milk and other milk products. Inclusion of many calcium-rich foods is also helpful. Table 3.2 shows some commonly eaten calcium-rich foods.

DIETARY NEEDS DURING PREGNANCY

Pregnancy is a very important stage in the life cycle. Many young women do not realize that their nutritional health during the years before they become pregnant has an effect on their future pregnancy and the development of the fetus. It is also important to realize that decisions the expectant mother makes about nutrition affects her baby's health and its future.

The growth and development of the fetus increases the daily nutrient needs of the expectant mother. An increased need for protein, folate, vitamin B_{12} (cyanocobalamin), calcium, phosphorus, magnesium, and iron is necessary

Foods Rich in Calcium

Food	Amount	Calcium Content (mg.)
Sardines, canned	3 oz.	371
Goat's milk	1 c.	326
Shrimp, boiled	3.5 oz.	320
Nonfat dry milk solids	1 c.	316
Nonfat yogurt	1 c.	302
Low-fat milk 2%	1 c.	297
Swiss cheese	1 oz.	272
Spinach, cooked	1 c.	244
Cheddar cheese	1 oz.	204
Oysters, raw	1 c.	202
Turnip greens, cooked	1 c.	198
Broccoli, cooked	1 c.	178
Salmon, canned	3 oz.	167
Tofu	4 oz.	108
Almonds	1 oz.	75
Kidney beans	1 c.	74
Green beans, cooked	1 c.	58
Cantaloupe	1/2	29

Source: "Nutritive Value of Foods," *Home and Garden Bulletin No. 72,* United States Department of Agriculture, Revised April 1981.

Table 3.2

to supply enough nutrients for fetal growth and development as well as for the mother's nutritional health. Even though the nutrient needs are much greater, the pregnant woman's energy needs only increase about 15 percent. This means the expectant mother should choose foods of high nutrient density rather than just empty calories. ***Nutrient density*** refers to foods that are excellent sources of essential nutrients but are low in calories.

The practice of good nutrition during pregnancy is critical. During the first trimester, or approximately thirteen weeks, inadequate nutrition or drug use can result in birth defects. By the end of the first trimester, the heart is completely formed and is beating and most of the organs are formed. During the second trimester, the fetus continues to grow and develop, and the bones become noticeably visible throughout the baby's body. The third trimester is also a very critical time for development. Deficiencies in certain nutrients can cause damage to the eyes, brain, and genitals as development is completed.

A pregnant woman's physician will probably recommend a well-balanced diet of nutrient dense foods. Because weight gain during pregnancy must be carefully monitored, it is essential that the expectant mother learn which foods provide the best nutrition without the added calories of excessive fat and sugar. Specifically, foods such as milk, lean meat, legumes, eggs, vitamin C-rich foods, dark green vegetables, and whole-grain breads and cereals are recommended. Table 3.3 outlines a daily food guide for the expectant mother.

The nutritional need for iron and folate increases substantially during pregnancy. Many physicians may even recommend supplements of iron and folate because it may be difficult for many pregnant women to get the amount that is needed in their diet. Iron is needed during pregnancy for hemoglobin synthesis. Hemoglobin is the protein in red blood cells that carries oxygen to the cells and carbon dioxide away from the cells. The daily need for iron increases from 15 milligrams for a nonpregnant female to 30 milligrams for a pregnant female. The need for folate increases from 180 micrograms to 400 micrograms during pregnancy. Folate is needed for the synthesis of DNA (material in the cell that contains the genetic code) and red blood cell formation. Food sources of these nutrients are listed.

Daily Food Guide for the Expectant Mother

Food	Number of servings
Milk and milk products	4
Meat and protein-rich foods	
Animal protein	2 (2 oz.)
Vegetable protein (dried beans and peas)	2
Fruit and Vegetables	
Vitamin C-rich fruits & vegetables	1
Dark green vegetables	1 or 2
Other fruits and vegetables	2
Bread and Cereals	
Whole-grain, enriched breads and cereals	4

Table 3.3

Food sources of iron include the following:

- dark green vegetables
- dried fruits
- fish
- legumes
- liver
- oysters
- red meat

Sources of folate include the following:

- asparagus
- beets
- broccoli
- romaine lettuce
- orange juice
- spinach
- turnip greens

The best advice for young women of childbearing age is to practice good nutrition during adolescence and the years before conception. Also, prenatal care through a clinic or by a physician can help reduce the risks of problems during pregnancy, labor, and delivery.

Summary

- ☐ Advances in medical science have shown an increasing relationship between the food consumed and good health. Doctors and dietitians also know the many ways diet is related to disease and recovery.
- ☐ The Dietary Guidelines for Americans suggest that people increase their intake of complex carbohydrates and decrease their intake of simple sugars.
- ☐ It is recommended that people reduce their sugar intake to only 10 percent of total calories and increase their complex carbohydrate intake to 50 percent of total calories.
- ☐ High-sugar foods have often been linked to health problems such as diabetes, obesity, heart disease, and tooth decay.
- ☐ Soluble fiber is dissolved in water and helps control diabetes and lowers blood cholesterol levels. Insoluble fiber is not able to be dissolved in water and therefore has different functions from soluble fiber. It helps food move through the digestive tract.
- ☐ Although there is no RDA for fat, it is recommended that fat intake be limited to 30 percent of the daily diet. High-fat diets lead to elevated blood cholesterol levels.
- ☐ Due to the increased incidence of hypertension in adults, health professionals recommend that persons without health problems limit their sodium intake to two grams per day. This would amount to approximately 2,000 milligrams per day.
- ☐ Calcium is essential for bone growth and the prevention of bone loss in adulthood. Calcium is also necessary for the transmission of nerve impulses and muscle performance, such as the heartbeat.
- ☐ Physicians and dietitians may recommend substitute food items to replace the calcium-rich milk and milk products in the diet. It is important to choose nutrient dense foods because milk and milk products supply an abundance of other essential nutrients besides calcium.
- ☐ Many young women do not realize that their nutritional health during the years before they become pregnant has an effect on their pregnancy and the development of the fetus. The decisions the expectant mother makes about nutrition will affect her baby's health and its future.
- ☐ An increased need for protein, folate, vitamin B_{12}, calcium, phosphorus, magnesium, and iron is necessary to supply enough nutrients for fetal growth and development as well as for the mother's nutritional health.

Vocabulary

calcium
carbohydrates
complex carbohydrates
diabetes
diverticulosis
electrolytes
fats
fiber
glucose
hypertension
lactase
lactose intolerance
linoleic acid
lipid
milk allergy
milk intolerance
nutrient density
oils
osteoporosis
simple carbohydrates

Review

1. List five words that are used for sugar on food labels.
2. What is the recommended intake of sugar according to the Dietary Guidelines for Americans?
3. What is the recommended intake of complex carbohydrates according to the Dietary Guidelines for Americans?
4. What health problems are related to high sugar diets?
5. How can people reduce the amount of sugar in their diet?
6. What is the difference between soluble and insoluble fiber.
7. Why is fiber important to good health?
8. How can the amount of fiber in the diet be increased?
9. What is the function of fat in the body?
10. Distinguish between saturated and polyunsaturated fats.
11. How can the amount of saturated fat in the diet be decreased?
12. What is the relationship between sodium and hypertension?

Critical Thinking

Keep a daily food record for yourself, a friend, or a family member. Evaluate the foods eaten using the guidelines for achieving low-fat diets found in this chapter. Give alternate food suggestions for the high-fat foods.

4

Retaining Nutrients in Food

ESSENTIAL ELEMENT

☐ Summarize methods for retaining nutrients in foods.(j1D)

OBJECTIVES

☐ Explain the factors that contribute to nutrient loss.

☐ Describe food preparation techniques that help to preserve nutrients.

☐ Discuss trends in new technology and food processing that help to improve food quality and nutrient retention.

While learning which nutritious foods to choose at the supermarket, it is important to learn how to store and prepare those foods so that most of the nutrients are retained. Several factors should be considered when storing and preparing foods to promote nutrient retention and to prevent nutrient loss.

NUTRIENT LOSS IN FOOD

Many people assume they are getting all the nutritional value of a food just by eating it. What they do not stop to consider is that quality, storage, and preparation techniques all influence the amount of nutrients that are retained in food.

Oxidation

Fruits and vegetables are most susceptible to nutrient loss because of their perishability. ***Perishable foods*** are those that deteriorate and spoil quickly. The quality of most fruits and vegetables is best when the produce is allowed to ripen on the vine, chilled immediately, and kept chilled until ready for use. However, vine-ripened products are more difficult to distribute because of their extreme perishability. Vegetables such as potatoes, yams, and onions are best if stored in a cool, dry, dark place. As soon as a fruit or vegetable is harvested, degradation begins.

Degradation is the term that describes the loss of quality that occurs after fruits and vegetables are harvested. Chilling soon after harvesting helps slow the degradation process. Vitamins A (retinol) and C (ascorbic acid) are most stable when protected from the oxygen in the air. ***Antioxidants*** are substances that prevent oxidation from taking place. ***Oxidation*** is a chemical change that occurs in foods as they age. The enzymes in the food may be activated by oxygen in the air and thus cause a loss of vitamins. When the oxygen is removed, the destructive effects of oxidation are greatly reduced. Once a fruit or vegetable is cut or a can is opened, it should be stored in an airtight container or wrapper and should be refrigerated.

Enzymes

The freezing of foods requires some precaution to ensure that valuable nutrients are not lost. Fresh vegetables should be blanched before freezing. ***Blanching*** is a method of deactivating enzymes by immersing the vegetables in boiling water or exposing to steam for a few minutes, then cooling the vegetables before freezing. Blanching destroys the enzymes in the food that would break down the nutrients. Once the food has cooled, it should be frozen immediately in airtight containers or freezer bags. Many fruits do not need any special preparation prior to freezing. Sugar helps to prevent the action of the enzymes, so fruits frozen with sugar may retain more texture and flavor than those frozen without sugar. However, it is best to ask extension home economists for information on preparing fruits and vegetables for canning or freezing. Meats should be wrapped airtight before freezing. Freezer temperature should be kept at 0°F.

Leaching

Much care must be taken to ensure that water-soluble vitamins and minerals are protected. ***Leaching*** is a term that refers to the loss of vitamins and minerals into water. Vitamin C, B vitamins, and some minerals are soluble in water. These vitamins are dissolved in the water in which fruits and vegetables are cooked or canned. Many people do not realize that when they discard the water the food has been cooked in, nearly half of the vitamins are poured down the drain. To prevent this loss of nutrients, fruits and vegetables can be steamed over water or boiled in a small amount of water so that the water can be reabsorbed into the food by the end of the cooking time. Nutrients also are retained if the water is used for soups or sauces. Fruits and vegetables should be washed before being cut to prevent nutrient loss during washing. The liquid from canned fruits and vegetables should not be discarded because it contains nutrients that have been leached into the liquid. The vegetable should be cooked in the liquid, and the liquid should be saved for use in soups, to cook rice, or to add to casseroles. More nutrients also will be retained if lengthy cooking times and high heat are avoided during preparation.

Light

Light speeds the oxidation process that causes loss of nutrients in some foods. Vitamins B_6 (pyridoxine), C, and riboflavin are most sensitive to light. Some nutrient loss can be prevented by packaging and storing food in opaque containers. Opaque is the opposite of transparent. Opaque containers do not let light pass through them. Also, limited exposure of cut surfaces to light helps in nutrient retention. Milk is packaged in opaque containers to lessen the loss of valuable riboflavin.

Heat

Heat is a factor in nutrient retention because it speeds the loss of nutrients. However, heat also is required to destroy the harmful microorganisms in food that cause food-borne illness. The oxidation process is accelerated by heat and slowed by cold temperatures. Vitamins that are sensitive to heat include vitamin A, B_6, C, and thiamin. Minerals are not affected by heat. Along with the high temperature of heat, there is greater nutrient loss the longer the food is exposed to the heat. Thus, the overcooking of fruits and vegetables should be avoided to aid in nutrient retention.

Manipulation

Manipulative procedures such as chopping and peeling cause nutrient loss in fruits and vegetables. ***Manipulative procedures*** involve actions that are done to food to change it from its original state. Some examples of manipulative procedures are chopping, grating, peeling, and slicing. Many nutrients are found close to the peelings of fruits and vegetables. Peeling, chopping, grating, and shredding vegetables and fruits cause a considerable loss of vitamin C. Thus, fruits and vegetables should be cut in large pieces and should be left in the skins when possible.

Alkalinity and Acidity

The nutrient content of foods can be affected by the alkalinity or acidity (pH level) of the food. The ***pH level*** refers to the acidity or alkalinity of the food. The pH values range from 0 to 14 with 7 representing neutrality. Values below 7 indicate increasing acidity, and values above 7 indicate increasing alkalinity. ***Alkaline*** is a water-soluble substance that neutralizes acid. Alkalies have a pH of 7 to 14. ***Acids*** are chemical compounds that have a pH level of 0 to 7 and have a sour taste. Acids react with a base to form salt. Acid solutions can destroy vitamin A, vitamin D (calciferol), and folacin. Alkalies can cause riboflavin, thiamin, and vitamins C and D to be destroyed in food.

In the past, many people have added a small amount of baking soda (an alkaline) to the water when cooking green vegetables. Although the baking soda does improve the color of the cooked vegetables, the nutrients that are sensitive to alkaline are lost. However, some foods benefit from the addition of acid substances. The acid used in pickling helps to preserve some nutrients but can cause the loss of others. The addition of acids such as lemon juice or cream of tartar when cooking cauliflower not only improves the color but is also beneficial to some nutrients.

TECHNIQUES THAT PRESERVE NUTRIENTS

Many foods in our culture are considered highly palatable when eaten in their raw form. ***Palatable*** refers to the acceptability of the food to the palate, or taste. Foods that appeal to a person's sense of taste, smell, and sight as well as foods with the appropriate temperature and texture are considered palatable. Fruits and vegetables are the foods most commonly eaten in raw form. This is especially important when considering the nutrients that are not lost through cooking. In many instances, however, cooking improves the palatability, flavor, color, texture, and digestibility of food. Cooking also destroys organisms and bacteria that could cause food-borne illness.

Consumers can take precautions to preserve the nutrients in the foods they prepare by following some food preparation practices. Microwave cooking, steaming, and stir-frying are methods that improve nutrient retention in foods. Simmering foods in a small amount of liquid for a minimal amount of time also helps to improve nutrient retention. Figure 4.1 lists some additional suggestions for preserving the nutrient content of foods prepared at home.

It is important to understand how nutrients are lost so that methods to improve nutrient retention can be used. Knowledge of principles of food preparation and storage can greatly

Preserving Nutrients

- Avoid overcooking. Prolonged exposure to heat causes loss of some vitamins.
- Cover refrigerated foods with tight-fitting lids, foil, or plastic wrap.
- Cut fruits and vegetables in large pieces. Chop immediately before use to avoid unnecessary exposure to oxygen.
- Freeze or refrigerate leftovers immediately after use. Leaving foods exposed to room temperature increases nutrient loss, promotes an environment for bacteria to grow, and increases rate of spoilage.
- Include raw fruits and vegetables in menu planning and food preparation.
- Refrigerate most products to reduce nutrient loss.
- Rinse foods in cold water. Do not soak. This causes loss of valuable water-soluble nutrients.
- Thaw frozen foods in the refrigerator. More nutrients are retained at cooler temperatures, and this also inhibits the growth of organisms that can cause food-borne illness.

Figure 4.1

improve the nutritional value of the foods that are cooked. Vitamins are the most easily lost of all the nutrients, so the greatest care must be taken with vitamin-rich foods. Some minerals are lost in leaching and manipulative procedures, but they are not destroyed by heat or oxidation. The nutritional value of carbohydrates, proteins, and saturated fats is not negatively affected by normal food preparation procedures.

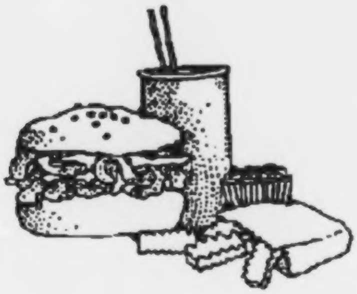
New Technology and Nutrient Retention

New technology and trends in food processing and preparation have concentrated on methods to help improve nutrient retention. Microwave cooking, stir-frying, quick-freezing, dehydration, and freeze-drying are new trends in preparation and preservation methods that allow for the optimum retention of nutrients.

Microwave Cooking. ***Microwave cooking*** is the cooking of food in a microwave oven, which uses electromagnetic energy to create heat. Research on the nutrient retention of foods cooked in the microwave oven shows that the foods retain as many, if not more, nutrients than foods prepared by more conventional methods. Microwave cooking tends to reduce the loss of some vitamins due to the fast, efficient method of heating. Leaching of water-soluble vitamins into the cooking water does not seem to occur with microwave cooking. Some studies have shown greater retention of folacin, thiamin, and vitamin B_6 in some foods cooked in the microwave oven.

These advantages are due to the fact that vegetables are cooked with very little or no water for a very short period of time. This limited exposure to heat also improves nutrient retention. Foods prepared in the microwave oven do not require the addition of any fat for cooking; therefore, dietary fat and calorie content are reduced.

Foundations of Food Preparation reports that ground beef patties cooked in the microwave oven have less fat and fewer calories after cooking than ground beef patties cooked by some other methods.



A microwave-cooked ground beef patty with a fat content of 24 percent contains approximately 134 calories after cooking. However, a ground beef patty with a fat content of 24 percent that is broiled in a conventional oven contains approximately 164 calories. These factors show that microwave cookery can be an effective method of food preparation that improves nutrient retention of some foods and reduces calories and fat.

Stir-frying. ***Stir-frying*** is a cooking method that is traditionally used in China and Japan. However, due to the nature of the stir-frying method, many Americans have adopted this popular cooking method. Stir-frying is a quick method of cooking that uses very little fat. A Chinese pan called a wok is recommended because of the wide cooking surface and sloping sides. Foods are cut into small pieces for stir-frying so they will cook fast. Stir-frying is considered a good choice for cooking because the fast cooking time improves nutrient retention. Since the vegetables are cooked only until they are slightly tender but still crisp, the natural flavors of the foods are so evident that the addition of butter or sauces is not needed. This also reduces fat and calorie content.

Quick-freezing. ***Quick-freezing*** is a method of food preservation that uses quick-freezing techniques such as air-blast freezing and freezing by liquid nitrogen. Research and experience have shown that the faster the food is frozen, the higher the quality. These methods not only reduce flavor, color, and nutrient loss, they also lessen the amount of tissue damage. This results in a food product with better texture. These procedures are discussed in detail in Chapter Thirteen.

Dehydration. ***Dehydration*** is a method of food preservation whereby water is removed from the food product so that microbial growth is inhibited. Microbial growth refers to the growth of microbes. ***Microbes*** are any bacteria that cause food spoilage and disease.

Dehydration requires food preparation procedures such as washing, trimming, and blanching. Nutrient loss can occur during these preparation procedures because the vitamins and minerals in the food are exposed to air, heat, light, and water. Dehydration can result in a significant loss of the water-soluble vitamins, especially vitamin C and thiamin. However, dehydrated or dried foods have a high mineral and fat-soluble vitamin content and also are sources of carbohydrates and proteins. Dried fruits have a high concentration of natural sugars, which results in a product with a high calorie content.

Freeze-drying. Advances in food preservation technology have introduced freeze-drying as a new method of drying foods. ***Freeze-drying*** is a food preservation technique in which food is first frozen and then dried using a vacuum chamber. The foods are thus reduced in weight and bulk. Many times they retain their size, but the weight of the food is decreased. In most instances, the texture and nutrient retention in freeze-dried foods are good. Sometimes the flavor is affected, especially in fruits and vegetables. Freeze-drying improves the quality of the dried food but is more expensive than other methods of food preservation.

Summary

- ☐ Quality, storage, and preparation techniques all influence the amount of nutrients that are available in food.
- ☐ Fruits and vegetables are most susceptible to nutrient loss because of their perishability. The quality of most fruits and vegetables is best when allowed to ripen on the vine, chilled immediately, and kept chilled until ready for use.
- ☐ Degradation of fruits and vegetables begins as soon as they are harvested.
- ☐ Nutrient loss can be due to oxidation, leaching, light, heat, manipulation, or pH levels.
- ☐ Consumers can take precautions to preserve the nutrients in the foods they prepare by following some food preparation practices. Microwave cooking, steaming, and stir-frying are methods that improve nutrient retention in foods.
- ☐ Microwave cooking, stir-frying, quick-freezing, dehydration, and freeze-drying are new trends in preparation and preservation methods that allow for the optimum retention of nutrients.

Vocabulary

acids
alkaline
antioxidants
blanching
degradation
dehydration
freeze-drying
leaching
manipulative procedures
microbes
microwave cooking
oxidation
palatable
perishable foods
pH level
quick-freezing
stir-frying

Review

1. What is the purpose of chilling some fruits and vegetables soon after harvest?
2. What are some ways to reduce leaching of vitamins and minerals into the cooking water?

3. How is exposure to light a factor in nutrient loss in some foods?
4. Why is heat a factor in nutrient retention? Why is heat important in food preparation?
5. How do manipulative procedures increase nutrient loss?
6. List important guidelines to remember that aid in preserving the nutrient content of foods prepared at home.
7. What are the advantages of microwave cooking when considering retention of nutrients?
8. How does stir-frying aid in nutrient retention?
9. What are the advantages of quick-freezing?
10. What are the disadvantages of freeze-drying?

Critical Thinking

Compare and contrast quick-freezing, dehydration, and freeze-drying according to time, labor, cost, and product quality factors. Use library resource materials to gather additional information.

5

Food Additives

ESSENTIAL ELEMENT

- ☐ Assess the safety factors of various intentional and incidental food additives.(j1E)

OBJECTIVES

- ☐ Define food additives.
- ☐ Distinguish between intentional and incidental food additives.
- ☐ Describe the functions of food additives.
- ☐ Explain the FDA regulations related to food additives.
- ☐ Assess the importance of the FDA's regulation of the food and drug industries.

Food additives are newsworthy items as consumers become more informed about food-related issues. The government agency that regulates the safety of our nation's food supply is the Food and Drug Administration (FDA). Although information regarding food additives and their safety receives much media attention, the FDA considers the hazards related to food poisoning as a much greater concern than the hazards of food additives. For centuries, people have been using food additives to improve taste or appearance, to keep food from spoiling, or to give variety to their meals. Spanish explorers' quest for spices and other flavorings for foods led to the discovery of the vanilla bean by Hernando Cortez. In the 1800s, Texas settlers discovered they could use the chili powder made from ground peppers to add flavor to meats and other foods.

Basically, the reasons food additives are used have not changed, but advanced scientific knowledge and technology have changed how they are used. The rapidly expanding population of the world increases the importance of food additives. Since only 2 percent of the population grows the food for the other 98 percent, much of the food would never reach consumers if food additives were not available. Many types of food additives are available that perform many different functions. They allow the food supply to be safe, palatable, and flavorful and give food an acceptable shelf life. Shelf life refers to the length of time a food can be stored without spoiling or deteriorating. In order to feel confident about the safety of the United States food supply, it is important for consumers to have factual information and a clear understanding about food additives.

FOOD ADDITIVES

Food additives are substances not normally consumed alone but are added to food intentionally or incidentally by being absorbed into the food. Food additives perform many beneficial functions that make food safe and flavorful with keeping qualities that people expect. These functions are listed in figure 5.1.

Functions of Food Additives

- **Appearance and Taste**
  The coloring agents, flavorings, flavor enhancers, and sweeteners improve taste and appearance.
- **Freshness**
  Preservatives prevent rancidity (spoilage) of fats, help retain natural color in foods, and retard spoilage.
- **Nutritional Content**
  Food additives improve the nutritional value of some foods through fortification and enrichment of important vitamins and minerals.
- **Processing and Manufacturing**
  Food additives such as stabilizers, thickeners, texturizers, and emulsifiers enable consumers to have convenient food products that blend, mix, and bake successfully with the body and texture that is desired.

Figure 5.1

The major reason for using food additives is to prevent food spoilage. Food spoilage caused by bacteria, fungi, molds or yeast can lead to serious food-borne illnesses. Food-borne illnesses are infections that occur when people eat food that has been contaminated by harmful microorganisms. A detailed discussion of food-borne infections and contamination of food is in Chapter Nine. Food spoilage also changes the flavor and texture of foods. Food additives keep salad dressings from separating, bread from molding, and cured meats safe for consumption. Without additives, many of the foods people enjoy would not be available in the desired form. The FDA has highlighted five major functions of food additives:

- to maintain product consistency
- to improve or maintain nutritional value
- to maintain palatability and wholesomeness and reduce spoilage by mold and bacteria
- to leaven and control acidity or alkalinity
- to enhance flavor or to give color

Intentional Food Additives

Food additives are classified into two categories: intentional food additives and incidental food additives. ***Intentional food additives*** are additives that are purposely added to foods to improve appearance, flavor, texture, or nutritive value or to prevent spoilage. Some examples of intentional food additives are food colorings added to improve appearance, vitamin C added to fruit drinks to improve nutritive value, and preservatives added to maintain freshness. Of all the intentional food additives used, 98 percent are citric acid, corn syrup, salt, and sugar. Many other intentional additives are used in processing food products. Table 5.1 identifies some intentional food additives.

Intentional Food Additives

Additive	Description
Anticaking Agents	Prevent lumping or caking of a finely powdered substance
Antioxidants	Delay or prevent a food product from turning rancid or browning
Colors	Give an appetizing or characteristic color to foods and increase product acceptance
Emulsifiers	Help to evenly distribute tiny particles of one liquid into another and improve the consistency, stability, and texture of food products
Flavor Enhancers	Supplement or heighten the original taste and/or aroma of food without changing or adding their own flavor
Flavors	Heighten natural flavor and/or restore flavors lost in processing
Humectants	Cause a food product to retain moisture
Leavening Agents	Affect cooking results, texture, and volume of food products
Maturing and Bleaching Agents; Dough Conditioners	Accelerate the aging process of the food product as well as improve its baking qualities
Nutrients	Enrich (replace vitamins and minerals lost in processing) or fortify (add nutrients that may be lacking in a person's diet) a food product to maintain or improve nutritional value
pH Control Agents	Change or maintain the acidity or alkalinity in food and drink products
Preservatives	Prevent food from spoilage by bacteria, molds, fungi, and yeast; extend the shelf life and protect the natural color or flavor of a product; prevent chemical reactions that cause food to deteriorate
Stabilizers, Thickeners, Texturizers	Impart body, improve consistency or texture, stabilize emulsions, and affect how the food feels in the mouth
Sweeteners	Make the smell or taste of food more agreeable or pleasurable

Table 5.1

Incidental Food Additives

Incidental food additives are substances that become part of the food indirectly. Sometimes incidental additives can get into food by coming in contact with the food while it is growing or being manufactured. For example, small pieces of packaging materials that may accidentally get into the food or trace quantities of substances such as pesticides used in the growing of the food are incidental additives. The FDA regulates incidental additives as they do intentional additives. Food processing companies must continuously check for materials from processing or packaging that may have drifted into the food.

Common Additives

Approximately 3,000 different food additives are common in the food supply. It is important to refrain from making generalizations about all food additives because no two are exactly alike. Each additive should be evaluated individually regarding its safety and purpose. Table 5.2 lists some common food additives and their purposes. These additives might be seen on labels of commonly eaten foods.

FOOD ADDITIVE REGULATION

The FDA is the government agency responsible for regulating food additives in the nation's food supply. The FDA is most concerned with the safety of the additives rather than with their effectiveness. The manufacturers are required to petition the FDA for permission to use a new food additive. This is a lengthy procedure that requires the manufacturers to show that the additive is safe for human consumption. It may take as long as several years for the additive to gain approval from the FDA.

The manufacturer must perform a series of chemical tests and animal feeding studies to indicate to the FDA that the additive adheres to the following guidelines:

- The additive must be proven to serve a necessary or useful purpose.
- The additive effectively performs the function for which it is intended.
- The additive does not conceal decay or disease.
- The additive is generally recognized as safe for human consumption.
- The additive is identified on the food label.

The manufacturer must submit the results of all tests conducted on the substance to the FDA for examination. Next, the FDA conducts a public hearing in which experts testify to the advantages and disadvantages of the proposed food additive. Following the hearing, the FDA determines whether or not to approve the additive. Even if the additive is approved, the manufacturer must follow strict regulations for use of the additive. The FDA outlines exactly in which foods the additive may be used and in what amounts. No food additives are approved indefinitely. All food additives are periodically reviewed by the FDA.

Many laws regulate the food industry. These laws and regulations serve to assure consumers that food safety is practiced. The authority to regulate food and food ingredients was given to the FDA by the ***Food, Drug, and Cosmetic Act*** of 1938. The rules and requirements for truth in labeling are also identified in this act. In 1958, the ***Food Additives Amendment*** was added to the act. This amendment requires manufacturers to receive FDA approval of an additive before it can be used in foods or food processing. The manufacturer also must show the FDA that the additive is safe in the ways it will be used in food.

Two groups of substances were excluded from food additive regulations. The first group is referred to as ***prior-sanctioned substances*** and refers to those substances that the FDA or United States Department of Agriculture (USDA) had determined were safe for use in food prior to the 1958 amendment. The second group of substances is identified on a list published by the FDA in 1958 known as the

Common Food Additives

Additive	Function
Acetic acid	pH control
Ascorbic acid (vitamin C)	nutrient, antioxidant, preservative
Beta carotene	nutrient, color
BHA (butylated hydroxyanisole)	antioxidant
BHT (butylated hydroxytoluene)	antioxidant
Calcium phosphate	leavening
Calcium propionate	preservative
Calcium sorbate	preservative
Carob bean gum	stabilizer, thickener, texturizer
Carrageenan	emulsifier, stabilizer, thickener, texturizer
Cellulose	stabilizer, thickener, texturizer
Citric acid	preservative, antioxidant, pH control
Corn syrup	sweetener
Dehydrated beets	color
Fructose	sweetener
Gelatin	stabilizer, thickener, texturizer
Glucose	sweetener
Glycerol monostearate	humectant
Guar gum	stabilizer, thickener, texturizer
Hydrogen peroxide	maturing and bleaching agent, dough conditioner
Hydrolyzed vegetable protein	flavor enhancer
Invert sugar	sweetener
Iodine	nutrient
Lactic acid	pH control, preservative
Lecithin	emulsifier
Locust bean gum	stabilizer, thickener, texturizer
Mannitol	sweetener, anticaking, stabilizer, thickener, texturizer
Modified food starch	stabilizer, thickener, texturizer
Monoglycerides	emulsifier
MSG (monosodium glutamate)	flavor enhancer
Paprika	flavor, color
Pectin	stabilizer, thickener, texturizer
Phosphoric acid	pH control
Polysorbates	pH control
Potassium sorbate	preservative
Propylene glycol	stabilizer, thickener, texturizer, humectant
Saccharin	sweetener
Sodium acetate	pH control
Sodium benzoate	preservative
Sodium bicarbonate	leavening agent
Sodium nitrate	preservative
Sodium nitrite	preservative
Sorbic acid	humectant, sweetener
Sorbitol	humectant, sweetener
Tartaric acid	pH control
Vanilla, vanillin	flavor
Yeast-malt sprout extract	flavor enhancer

Table 5.2

GRAS list. GRAS is an acronym for *generally recognized as safe*. The ***GRAS list*** contains the names of substances that have been determined long ago to be safe for use in foods or for which there is published scientific evidence of their safety. Substances such as salt, spices, and sugar are on the GRAS list. The FDA and USDA continues to monitor new scientific research as it applies to food additives that are prior-sanctioned substances and/or on the GRAS list.

Due to the increasing use of color additives, Congress passed legislation that governed color additives in 1960. The amendments that require FDA approval of dyes used in cosmetics, drugs, foods, and some medical devices are referred to as the ***Color Additives Amendments***. Another provision called the Delaney Clause was included in the Food Additives Amendment in 1958 and in the Color Additive Amendments in 1960. The ***Delaney Clause*** forbids the use of any additive that has been shown to cause cancer in humans or animals. Some scientists believe that the Delaney Clause is too restrictive because scientific knowledge and technology have improved greatly since the adoption of the Delaney Clause.

The ***Fair Packaging and Labeling Act*** of 1967 clearly identifies guidelines for manufacturers in regard to information that must be included on packaged foods. Specific details of the Fair Packaging and Labeling Act are discussed in Chapter Twelve.

Safety of Food Additives

Consumers who lack factual information about food additives may believe that all food additives are dangerous. Many consumers may believe that synthetic additives are not safe. ***Synthetic additives*** are manufactured additives that have the same chemical composition as those that occur in nature. An example of a synthetic additive is imitation vanilla flavoring. Scientists are able to duplicate the chemicals in the vanilla bean extract that is used to make vanilla extract. The imitation vanilla product is less expensive to manufacture than vanilla extract.

Many toxic and poisonous substances that occur naturally in food are much more hazardous to humans than any of the synthetic additives. A ***toxic substance*** is one that causes illness and injury when ingested in a certain quantity. An example of a toxic substance in a natural product is solanine. This toxin is found in the green spots on potatoes and in the potato shoots. It occurs naturally when the potatoes are exposed to light and allowed to grow shoots. Solanine prohibits nerve impulses from getting to the brain. Another example is honey. Honey can contain the botulinum organism in a strength that can cause death in infants.

Often the FDA removes items from the GRAS list that need further testing, or sometimes a product may be banned from use. Such was the case of the artificial sweetener cyclamate, which was banned in 1970 because it was believed to cause cancer in humans. Some food colors have been banned by the FDA because they were suspected of causing cancer or allergic reactions in some individuals. The antimicrobial agents (those that prevent the growth of microorganisms) nitrate and nitrite have received much attention because they can be converted to nitrosamines in the human body, and nitrosamines have been shown to cause cancer in animals. Nitrosamines are organic compounds formed in the body from nitrates and nitrites. However, these two antimicrobial agents protect against bacterial growth, especially the highly poisonous *Clostridium botulinum* toxin. *Clostridium botulinum* is the name of the bacterium that causes the illness botulism. Even in minute amounts, this toxin can cause severe illness and even death. At the present time, no other additives on the market perform all the functions of nitrate and nitrite.

Research studies continue to uncover more useful information about food additives and the naturally occurring toxins in food. These studies result in providing Americans with the safest food supply in the world. ***Consumers*** are people who purchase and/or use goods and services to meet their personal and family needs. Consumers should seek factual information from reliable sources in regard to food safety.

THE FOOD AND DRUG ADMINISTRATION

The FDA is an agency of the United States Department of Health and Human Services. The main function of the FDA is to ensure that the United States food supply is pure, safe, and wholesome and to enforce the Food, Drug, and Cosmetic Act of 1938 and its amendments. Figure 5.2 lists the current responsibilities of the FDA.

FDA Regulation of the Food and Drug Industries

Good Manufacturing Practice Regulations. These regulations are mainly concerned with proper sanitation practices, proper hygiene, and rodent and insect control. However, these regulations also limit the amount of food additives and color additives that are used in foods. Manufacturers are expected to use only the amount that is needed to achieve the desired effect in the food.

Labeling Regulations. Labels must supply only truthful information and must not make any misleading statements. Specific guidelines for information required on labels include the following:

1. Labels must be in English.
2. Labels must list the name and address of distributor, manufacturer, or packer.
3. Weight of contents must be listed.
4. Labels must show the common name of the food and each ingredient in order of predominance in the food.
5. Artificial flavorings and colorings must be listed for all foods except butter, cheese, and ice cream.
6. Labels must list all chemical preservatives.
7. Foods for special dietary needs must list vitamin and mineral content.

Levels of Contaminants. The FDA sets standards of safe tolerance levels of pesticide chemical residues used in or on raw agricultural products. Pesticide chemicals are insecticides and other chemicals used for pest control. Foods cannot be sold if they show evidence of unsafe levels of pesticide chemical residues. Sanitary safeguard regulations ensure that food contaminated with natural filth (dirt and soil particles) and poisonous and harmful substances is prohibited from being sold.

Nutritional Regulations. These regulations serve to assure the public that the composition and nutritional value of foods give the consumer an honest representation of foods that will supply the daily nutrient requirements.

Standards of Identity. These regulations state that foods labeled with a particular name must meet certain requirements for that food.

Thermal Processing Regulations. These regulations set forth proper procedures for processing low-acid and acid foods in hermetically sealed (airtight) containers.

Figure 5.2

Enforcing FDA Regulations

The FDA employs inspectors and investigators to enforce the laws that pertain to the food, drug, and cosmetic industry. The FDA inspectors visit drug and food plants to test samples of foods and other products to make sure that they adhere to the law. FDA district offices have laboratories where chemists and other scientists test and evaluate samples of foods and other products to be sure they meet the standards set by the law. In order to maintain control over the labeling, purity, quality, and wholesomeness of foods, the FDA performs several functions. These functions include the following:

- establishes and enforces the regulations that apply to new food additives and the amounts that can be used
- inspects and checks for the safety of food colors
- inspects imported food products to be sure they adhere to federal law
- issues the guidelines that ensure consumers that the composition and real value of the food products they buy are in line with the congressional mandate to "promote honesty and fair dealing in the interest of the consumers"
- sets the standards for the amounts of pesticide chemical residues that may be found on food crops
- checks shipments of food crops to be sure they are within the stated guidelines
- works with state and local inspectors to remove contaminated products from the marketplace

If FDA inspectors or investigators find adulterated or misbranded food items, those products can be removed. ***Adulterated foods*** are food products that are inferior in quality due to some mishap that occurred during processing or packaging. ***Misbranded foods*** are those foods that have been labeled incorrectly. For example, if tomato sauce was labeled as tomatoes, it would be considered misbranded. The FDA has authority under federal court to seize the items and charge the business or persons responsible with violating federal law. They would be subject to criminal prosecution.

Protecting the nation's food supply is considered a major responsibility of the U.S. government. This elaborate system of regulations, inspections, and investigations enables American consumers to purchase food, drugs, and cosmetics with confidence that the products are of pure and wholesome quality.

Summary

- ☐ The Food and Drug Administration (FDA) is an agency of the United States Department of Health and Human Services. The main function of the FDA is to ensure that the U.S. food supply is pure, safe, and wholesome and to enforce the Food, Drug, and Cosmetic Act of 1938 and its amendments.
- ☐ The FDA considers the hazards related to food poisoning a much greater concern than the hazards of food additives.
- ☐ Food additives perform many beneficial functions that make the food safe and flavorful with acceptable keeping qualities.
- ☐ Intentional food additives are additives that are purposely added to foods to improve appearance, flavor, texture, or nutritive value or to prevent spoilage.
- ☐ Incidental food additives are substances that become part of the food indirectly. Sometimes incidental additives can get into food by coming in contact with the food while it is being grown or being manufactured.
- ☐ It is important to refrain from making generalizations about all food additives because no two are exactly alike. Each additive should be evaluated individually regarding its safety and purpose.
- ☐ Manufacturers are required to petition the FDA for permission to use new food additives. This is a lengthy procedure that requires the manufacturers to show that the additive is safe for human consumption.
- ☐ Many laws regulate the food industry. These laws and regulations serve to assure consumers that food safety is practiced. The authority to regulate food and food ingredients was given to the FDA by the Food, Drug, and Cosmetic Act of 1938.

Vocabulary

adulterated foods
Color Additives Amendment
consumers
Delaney Clause
Fair Packaging and Labeling Act
food additives
Food Additives Amendment
Food, Drug, and Cosmetic Act
GRAS list
incidental food additives
intentional food additives
misbranded foods
prior-sanctioned substances
synthetic additives
toxic substance

Review

1. What are food additives? What beneficial functions do they perform?
2. What is the major reason for using food additives?
3. Explain the difference between incidental food additives and intentional food additives.
4. List five of the intentional food additives and describe the functions they perform.
5. Explain the procedure manufacturers must follow to gain approval from the FDA to use a new food additive.
6. What is the purpose of the GRAS list?
7. Explain the purpose of the Delaney Clause.
8. Give examples of toxic substances that can be found naturally in foods.
9. List six major responsibilities of the Food and Drug Administration.
10. Explain the procedures used by the FDA to enforce the laws that pertain to the food, drug, and cosmetic industry.
11. What are the consequences manufacturers face if they fail to abide by the FDA regulations?
12. Why is protecting the nation's food supply the responsibility of the U.S. government?

Critical Thinking

Consider the controversy concerning the abolishment of the Delaney Clause. Give supporting arguments for both sides of the controversy. Consult your school library for additional resource information on the Delaney Clause.

6

The World Food Supply

ESSENTIAL ELEMENT

- ☐ Determine factors affecting the world food supply.(j1F)

OBJECTIVES

- ☐ Discuss factors related to supplying food to meet the nutritional needs of the world.
- ☐ Describe the technological factors affecting the world food supply.
- ☐ Explain the ecological factors affecting the world food supply.
- ☐ Summarize the social factors affecting the world food supply.

Providing food for the world's population continues to plague the leaders of both rich and poor countries. Hunger in developed and developing countries is a continual problem that must be addressed by the awareness and actions of citizens of the United States and other nations. Food issues and negotiations are of increasing importance in world politics and foreign relations. Worldwide trade has made the countries of the world dependent on one another. For example, the United States agricultural economy depends heavily on sales of agricultural food products to foreign countries.

Problems involved in feeding the world's people include the increasing population of the world, the conditions in developing countries, pollution, food taboos, insufficient protein sources in the food supply, and ignorance of nutrition and health information. Solutions to these problems involve politics, economics, societal behaviors, science, and technology.

MEETING THE NUTRITIONAL NEEDS OF THE WORLD

Many people believe that producing more food is the answer to the world food problem. The complex problems involved in providing food for the world population have been studied and researched by many sociologists, scientists, economists, and politicians. They have discovered that many factors are related to supplying food to meet the nutritional needs of the world. These factors include the following:

- increasing world food production
- nutrition education
- traditional value systems
- social organizations
- land ownership and tenure relationships
- political climate
- lack of income
- transportation and storage facilities
- customs, superstitions, and religious influence
- illiteracy

Increasing World Food Production

It is estimated that by the year 2000, the world's population will reach six billion, and 80 percent of these people will live in the developing countries. The developing countries are the nations with severe economic problems that are working to become more industrialized. The developed countries are industrialized nations whose food production and supply can provide a sufficient standard of living for its citizens. The ability to produce enough food to feed this growing population already exists. However, most of the food is produced in the more advanced and industrialized developed countries of the world.

The developing countries, whose agricultural and economic capabilities are limited, must increase food production within their own countries. They do not have the resources to import (to bring goods in from other countries) all the food that is needed for their growing populations. The developed countries will have to assist the developing countries in domestic agricultural reform, and the developing countries will have to work toward reducing the rate of population growth and increasing economic development that raises per capita income. ***Per capita income*** is the average amount of income for each person living in the country.

Postharvest technology is a major problem for the developing countries. ***Postharvest technology*** is the knowledge and resources to preserve and store food crops for future consumption. Even though some of the developing countries are able to produce food in sufficient quantities to feed their populations, they do not have the resources and technology for canning, freezing, and refrigeration to preserve the food for future consumption.

Nutrition Education

Lack of education concerning nutritional needs for good health is a factor in the many problems associated with hunger and malnutrition. ***Hunger*** or ***undernutrition*** is a state of weakness caused by the need for food. It occurs when the body lacks nourishment from any kind of food. ***Overnutrition*** is the intake of excessive amounts of food that leads to overweight and obesity. ***Malnutrition*** (or "bad" nutrition) is the term that refers to either undernutrition or overnutrition. Nutrition education is important because often the food needed for a balanced diet is available, but people choose other items because they lack the education and information to make wise food choices based on nutritional needs. It is important for people to eat the right kinds of food.

The diets in developing countries are based on cereals and grains, lacking the protein needed for good health. People living on low incomes or in poverty need nutrition education to help them learn to achieve a balanced diet from the food resources available.

Traditional Value Systems and Social Organizations

The world is made of people from many different cultures that have different attitudes and beliefs. It is known that poverty is the main cause of hunger in the world. Many people tend to blame the citizens of developing countries for their poverty and hunger problems. They feel that if the poor had fewer children, there would be more food. It is true that when there are more people to feed, a smaller amount of food will be available for each one. However, for people living in poverty, having many children is a means of survival. The high infant mortality rates in developing countries mean that families can expect only a few of their children to reach adulthood. In those countries, children are needed to help earn extra income for the family and to take care of their parents in old age. It is a cycle. Poverty causes hunger, and hunger causes illness, lost wages, and more poverty.

Land Ownership and Tenure Relationships

One of the ways to combat hunger is for the developing countries to produce enough of their own food to feed the population. Food production in the United States far exceeds what is needed to feed American citizens. However, farmers in developing countries do not have the land, water, or resources to produce food in the same manner.

Many farmers in developing countries do not own their own land but instead work for a landlord for minimal wages. In many countries, tenure relationships exist between landowner and farmer. ***Tenure relationships*** are agreements between the landowner and the farmer whereby the farmer pays the landowner money, crops, or both in order to farm his land. Farmers who farm their own land face strict government policies that limit crop prices and reduce available credit. Fertilizer prices are so high that farmers cannot afford to use it. Agricultural education that would help increase production is very limited or nonexistent in developing countries.

Political Climate

Many people feel that governments around the world have not made world hunger and malnutrition a priority. Very few countries have institutions or organizations whose goals are to end world hunger. Many developing countries do not place much emphasis on agricultural development, and therefore, they fall behind in technology and production. In many poor countries, the government officials and politicians are not even aware of the hunger problems in their own countries. They exclude themselves from exposure to the poor people who have no political voice.

Lack of Income

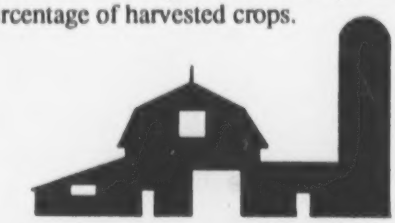
As mentioned previously, poverty and hunger are partners in a vicious cycle. Individuals and families who live in poverty face many overwhelming obstacles such as the following:

- lack of land on which to grow their own food
- lack of funds to purchase farm equipment if they do own land
- lack of funds to purchase nourishing food

Poverty and hunger cause illness and weakness that prohibit people from holding jobs that could produce income to buy food. This cycle seems to follow generation after generation.

Transportation and Storage Facilities

Developing countries lack modern facilities for storing and distributing the crops they raise. The absence of modern farm equipment and supplies, poor roads, and limited access to trucks and other means of transportation inhibit the distribution of food. Poor storage conditions invite insects and pests that destroy a large percentage of harvested crops.



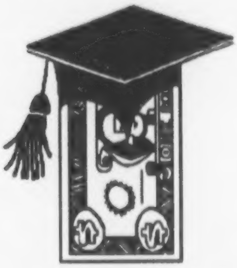
Customs, Superstitions, and Religious Influence

In every country in the world, different customs and traditions surround family life, including food habits and mealtimes. It is very important to consider the complex issues surrounding how customs, religions, and other cultural habits influence food habits around the world. In many countries the diet is mainly vegetarian. Even though they might be hungry and malnourished, the people in these countries do not eat any meat or animal products for cultural or religious reasons.

Superstitions about food products exist in many cultures of developing countries. People living in these cultures believe that consuming certain foods brings evil or hardship to a family. The people working with these cultures, such as Peace Corps volunteers or missionaries, must have an understanding of the various customs and religious beliefs of the community.

Illiteracy

In the countries where the population continues to grow at a rapid rate, a large percentage of those reaching adulthood are illiterate. These countries do not have the funds or facilities to provide for education of the population. With the ability to read and write comes the ability to obtain better jobs and to learn about the importance of good nutrition and health. Even one educated person in a family could make a vast difference in the future of the young children.



Education is not a priority with people who are starving. The developing countries must have overall economic development to include public education for their nation's children and illiterate adults.

TECHNOLOGICAL FACTORS AFFECTING THE FOOD SUPPLY

Science and technology continue to be important factors in finding solutions to world food problems. ***Technological factors*** are those factors that have been influenced by the advances in science and industry. Included in these advances are research and new developments in the following areas:

- agricultural capabilities
- food production
- food supply
- marketing
- biotechnology
- genetic engineering
- aquaculture

An investigation into these new trends can give people a better understanding of how to find solutions to the problems associated with feeding the world's population.

Agricultural Capabilities and Food Production

Of all the suggested methods for increasing the world food supply, the capability to increase the crop yields per acre and to introduce new nutrient-rich crops in cultivated areas seem to be the most satisfactory solutions. In a world where people possess the knowledge and technology to solve these problems, it only seems natural that this information should be applied to the world food supply.

One of the possibilities involves the introduction of food crops that could be cultivated in many areas of the world which are presently grown only in some remote areas. An example is the many varieties of potatoes that have different growth habits but could easily be grown in many parts of the world. New varieties of wheat, rice, and sorghum that yield two to

three times as much grain per pound of fertilizer have been developed. The new rice has a very short growing season that enables farmers to plant and harvest as many as three crops a year on the same land.

Another new agricultural capability is the research involving the winged bean plant. This plant has been grown in Southeast Asia for many years, but the National Academy of Sciences began studying it only recently. The winged bean plant grows well in different soils, even those found in tropical climates. This plant is completely edible and does not need to be fertilized during the growing season. It is much easier to grow than the soybean, and, when combined with corn, becomes a product with the protein equivalent of milk and provides a good source of vitamin A. Research into new crops for developing countries is a step toward improving the world food supply.

The Food Supply

The food supply is all of the food that is available to the world's population. The demand for food increases with the increasing population. Ongoing research and new developments are important factors in planning for a future food supply that will be adequate to feed the people in the world. The world food supply depends not only on food produced during the current year but also on food reserves. ***Food reserves*** are the surplus products not consumed during previous years. These reserves are carefully stored so that they may be used at a later date.

Increases in the food supply can occur through greater farm yields. ***Farm yields*** refer to the output or amount of crops produced on a farm. Farm yields can be improved by the use of newer improved varieties of grains.

Some improved varieties require greater amounts of energy, fertilizer, and water than the other types of grains. The development of these high-yield grain varieties has been referred to as the ***green revolution.*** Some problems did arise as a result of the green revolution. Even though the developed countries could afford the additional water, energy, and fertilizers necessary to produce these high-yield grains, the farmers in the developing countries could not afford to purchase the high-priced seeds and the fertilizers. They also did not have access to the energy and water resources that were needed. Even though the purpose of the research that led to the green revolution was to develop grains that would increase crop yields in developing countries, it has been labeled unsuccessful because of the high cost and demand for unavailable resources.

Research scientists continue working to develop high-yield grains that have the same favorable characteristics but do not require the large amounts of water and fertilizers. Scientists are also trying to develop a grain that would resist insects and disease.

The development of new sources of food also contributes to increasing the food supply. Researchers are working with crops such as coconuts, cottonseed, peanuts, and soybeans to develop a food product from the protein-rich oilseed meal that is left after the oil has been removed. The possibility exists that these products would provide people in developing countries with an inexpensive protein food that could easily be grown in their own countries.

Marketing

Successful marketing of farm products requires food processing, storage, and transportation. These services are needed to distribute the food to the people in edible form and to provide storage for surplus reserves. Many losses occur due to insects, molds, pests, and spoilage. Technological advances in controlling these problems reduce the amount of loss and thus make more food available. Advances in preservation methods also aid in reducing food losses due to spoilage. Improvements made in roadways and waterways in the developing countries can speed up the handling process and reduce losses from transporting food products. Efficient methods of storing and transporting available food products are major factors that contribute to the quality and quantity of the food supply.

Biotechnology

Biotechnology is a science that combines technology, engineering, and knowledge of biological systems to develop and improve agricultural processes such as food productions. This information is used to develop new products and to solve problems related to humans and other living organisms. Biotechnology has made advances in the development of new foods and new food processing methods. The development of new food additives that have been biologically produced (produced in a laboratory) is a result of biotechnology. The development of inexpensive kits that can identify harmful microorganisms in food is a major contribution to food safety. Products such as new types of beef that are lower in saturated fat with the same flavor, protein, and texture as regular beef are results of biotechnology. This field has certainly opened up the possibilities for many new developments in the food industry.

Genetic Engineering

Genetic engineering is another area in which research and science lead to new developments and discoveries in the food industry. ***Genetic engineering*** is the transmission of genetic information that does not normally occur in nature into the cells of living organisms. For example, genetic engineering has been used to improve breeds of animals that produce a more desirable food product. Genetic engineering is responsible for the development of potatoes with an increased protein content. The advances in this area have opened new doors to the development of many nutritious foods with improved amino acid content and increased amounts of vitamins. Amino acids are the building blocks of protein and are essential for all living cells.

Aquaculture

Aquaculture is the cultivation of food organisms that can be raised in water. Along with fish and shellfish, some vegetables that have been grown successfully in water are considered aquaculture. This has become an important industry, not only because Americans are eating more fish and seafood, but because of the contributions to the food supply that it can make.

Fish and seafood products serve as the major sources of protein for many populations in the world. The ability to increase the amounts of these products through successful aquaculture is a factor in improving the world food supply. Aquaculture is discussed in more detail in Chapter Twenty-one.

ECOLOGICAL FACTORS AFFECTING THE FOOD SUPPLY

Ecological factors are the environmental factors that affect the world food supply. Natural and human-made disasters, climate, and soil have a tremendous effect on the quantity and quality of food available in different regions of the world.

Disasters

Throughout history, both natural and human-made disasters have caused food problems in the world. Natural disasters, such as droughts, earthquakes, famines, and floods, seriously impact the food supply in the nations affected. Human-made disasters, such as wars, also can affect the food supply. Misuse of natural resources can have a disastrous effect on a small country's food supply.

One way to prevent mass starvation, hunger, and death in these affected countries is through international relief efforts in which many countries work together to aid the stricken nation. To provide disaster relief, there must be adequate storage of food reserves to meet the increased demands for food. Technological advances in reducing food losses due to spoilage and pests during storage have helped to increase the food reserves. New and more efficient methods of transporting food also have enabled the relief efforts to be more successful. These cooperative relief efforts require the coordination of the aiding countries. The relief efforts are arranged by organizations such as the Food and Agricultural Organization and the United Nations.

Climate

The climate of a region in the world affects the agricultural capabilities of that region. For example, tropical climates create ideal growing conditions for rice. Corn grows better in subtropical or temperate regions. One of the reasons for the bountiful food supply and successful agricultural production in the United States is the moderate climate.

Changes in weather patterns can cause changes in precipitation that bring about crop failure. These changes in precipitation can cause floods or droughts that completely destroy the crops in a region. Famines in China and India were directly related to crop failures caused by weather. A ***famine*** is a severe shortage of food that causes serious illness and death from starvation.

Soil

The world food supply is affected by two factors: the amount of suitable land available for cultivation and land management. Even though a large amount of suitable land exists in Africa, the expense of clearing, controlling disease, irrigating, and leveling makes it not worth the cost. Agricultural authorities believe it is better to work to improve crop production on land that is already developed. Soil mismanagement is another problem affecting the quantity and quality of the food supply. It is estimated that inadequate land management is responsible for approximately 2.5 million acres of land used for crops in the developing countries being unsuitable for agricultural production. In the United States alone, valuable topsoil is lost every year due to wind and water erosion.

SOCIAL FACTORS AFFECTING THE FOOD SUPPLY

Along with the technological and ecological factors, social and cultural factors affect food consumption around the world. Societal, cultural, and religious laws have great influence on all aspects of food consumption.

Societal and Cultural Food Patterns

Society refers to a group of people who share a common culture and live within a common region. ***Culture*** refers to the beliefs, traditions, and values that are shared by the people within a society. In the American society, citizens depend on advances in science and technology to continually improve the way food is produced, harvested, and transported. However, within the American society, there are subcultures that restrict the use of certain types of food. For example, the Amish culture restricts the use of advanced technology in producing, harvesting, or transporting food for the Amish people.

Within all societies, many different cultural laws affect food consumption. In some instances, governments restrict the import or production of certain foods due to cultural or religious beliefs. In most societies, food is used as a symbol of love, affection, and social ties to family and friends. In many societies within the developing countries, certain rituals surround the gathering, preparing, and serving of food. These food traditions serve to strengthen family and social relationships.

For centuries, food has been used as trade for economic and political reasons. Even in remote areas of the world, tribal societies exchange food products that benefit the members of each tribe. Food is used as a gift to strengthen social ties, and it is used between countries as an economic alliance. An ***economic alliance*** is a close association or relationship between countries to economically support one another through the sale of goods and services. In political circles, food is used before and after meetings with international leaders to relieve the tension often associated with politics.

In all societies, food has been used to distinguish social class and to symbolize wealth and prestige. The cultural beliefs, traditions, and values of people within societies determine the customs for how food is used.

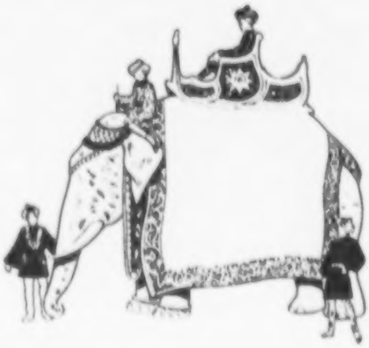
Religious Customs

Religious beliefs within societies influence the many rituals and customs surrounding food. Some societies believe that avoiding certain foods protects them from harm. Many pregnant and nursing women avoid eating certain foods because they believe the foods cause harm to the unborn child. Some religions have customs surrounding the consumption of certain foods during religious holidays or special holy days. Many religious ceremonies are accompanied by feasts with family members and friends. In the United States culture, religious ceremonies such as baptisms, weddings, and funerals are usually followed by a gathering involving food. Figure 6.1 lists various regional and religious food customs of the world.

Food Customs of the World

Africa

The dietary guidelines for the followers of Islam, one of the religions of Africa, are outlined in the *Koran*. It forbids the eating of animals that have been beaten or strangled or that have died from disease. Animals must be slaughtered according to proper ritual. The fast of Ramaden occurs during the ninth calendar month. During this time, Muslims (followers of Islam) must not eat from sunrise until sunset. Food eaten after sunset must be light. In most regions of Africa, most food is eaten with the fingers. Therefore, a hand washing ritual occurs before and after each meal.



India

The Hindu religious doctrine prohibits consumption of meat. The Hindus believe this practice will allow them a life of nonviolence.

Middle East

The Middle East is a large area in Asia that includes Egypt, Iran, Iraq, Israel, Jordan, Lebanon, Saudi Arabia, Syria, and Turkey. The primary religions are Judaism and Islam. Both of these religions forbid their followers to eat pork. Lamb is the main meat that is eaten. The Jewish people eat kosher foods, which are foods that must be prepared according to Jewish law. Jews are not allowed to cook or eat meat and dairy products together. Foods such as eggs, fruits, vegetables, and breads made with vegetable shortening are called pareve. Pareve foods can be cooked and eaten with meat and dairy foods. In Saudi Arabia, the Bedouins (nomads) eat camel meat that has been boiled in sour milk until tender.

Peru and Ecuador

The papa (potato) is the staple food in these countries. The methods and traditions for preparing the many potato dishes came from the Inca Indians who developed more than 100 varieties of potatoes centuries ago.

Figure 6.1

81

Summary

- Problems involved in feeding the world's people include the increasing population of the world, the conditions in developing countries, pollution, food taboos, insufficient protein sources in the food supply, and ignorance of nutrition and health information. Solutions to these problems involve politics, economics, societal behaviors, science, and technology.
- Nutrition education is important because many times the food needed for a balanced diet is available, but people choose other items because they lack the education and information to make wise food choices based on nutritional needs.
- Poverty and hunger are partners in a vicious cycle. Poverty and hunger cause illness and weakness which prohibit people from holding jobs that could produce income to buy food.
- The world food supply depends not only on food produced during the current year but also on food reserves.
- Efficient methods of storing and transporting available food products are major factors that contribute to the quality and quantity of the food supply.
- Natural and human-made disasters, climate, and soil have a tremendous effect on the quantity and quality of food available in different regions of the world.
- The cultural beliefs, traditions, and values of people within societies determine the customs for how food is used.

Vocabulary

aquaculture
biotechnology
culture
ecological factors
economic alliance
famine
farm yields
food reserves
genetic engineering
green revolution
hunger
malnutrition
overnutrition
per capita income
postharvest technology
society
technological factors
tenure relationships
undernutrition

Review

1. List the factors related to supplying food to meet the nutritional needs of the world. Briefly explain each one.
2. How can the developed countries assist the developing countries in providing food for their growing populations?
3. Why is nutrition education especially important for low income families?
4. What are some problems faced by farmers in developing countries?
5. List the obstacles faced by individuals and families living in poverty.
6. Give an example of how customs, superstitions, or religious beliefs affect food habits.
7. What are the technological factors that affect the food supply? Summarize how each factor impacts the food supply.
8. State examples of natural and human-made disasters that affect the food supply. Explain how relief efforts aid countries affected by disasters.
9. How are climate and soil related to the quantity and quality of the food supply?
10. Summarize how religious and cultural traditions affect food consumption.

Critical Thinking

Plan a food aid drive for the people living in a developing country. How would you organize it? What problems might you encounter? Explain how you might evaluate the success of this project.

7

Food and Nutrition from an International Perspective

ESSENTIAL ELEMENTS

- ☐ Describe international organizations contributing to improved nutrition.(j1G)
- ☐ Relate nutrition to international trade, governmental relations, and world progress.(j1H)

OBJECTIVES

- ☐ Discuss the various functions of international organizations that deal with the world food supply.
- ☐ Describe the organizations that provide food assistance in the United States and the world.
- ☐ Analyze the problems of world hunger and the possible solutions.
- ☐ Explain the role of world food trade policies.

Hunger and malnutrition are problems that have faced the world throughout the history of civilization. For many years, it was believed that the problems associated with hunger and malnutrition were due to overpopulation and insufficient food production. However, it is now believed that the cause of hunger and malnutrition is poverty. ***Poverty*** is a standard of living in which there is not enough income to provide for basic needs such as food, clothing, and shelter.

Hunger and malnutrition are problems for foreign nations as well as for the United States. Many organizations exist for the purpose of fighting hunger in the world. World food trade policies affect how food is distributed to the hungry people throughout the world. The problems of hunger, malnutrition, and poverty must be addressed through a greater awareness by politicians and citizens.

INTERNATIONAL ORGANIZATIONS

Many organizations work worldwide and within the United States toward finding solutions to the problems of hunger. Some of these organizations operate through governments or international agencies. Others are funded by public donations. Each of these organizations works toward achieving these basic goals:

- to raise people's levels of nutrition
- to raise people's standard of living
- to improve the efficiency of food and agriculture production
- to improve the distribution of food and agriculture products
- to better the conditions of rural populations

Food and Agriculture Organization

The ***Food and Agriculture Organization (FAO)*** was established in 1945 as an agency of the United Nations (UN). The FAO organizes research and program development for topics that affect the world food supply. The headquarters for the FAO is in Rome, Italy. The members of the FAO include approximately 160 countries. Some of these countries are UN member nations and some are not. The FAO works primarily in developing countries to improve agricultural production, use of soil and water resources, nutrition, and agricultural technology. Figure 7.1 states the purposes and goals of the organization.

The FAO also works internationally to provide a stable market for agricultural products and with other organizations such as the World Bank and the World Health Organization.

Preamble to the Constitution of the Food and Agriculture Organization

(Ratified by 42 countries in 1945)

The nations accepting this Constitution being determined to promote the common welfare by furthering separate and collective action of their part for the purposes of:

- Raising levels of nutrition and standards of living of the people under their respective jurisdictions,
- Securing improvements in the efficiency of production and distribution of all food and agriculture products,
- Bettering the conditions of rural populations,

And thus contributing toward an expanding world economy,

Hereby established the Food and Agriculture Organization of the United Nations.

Figure 7.1

World Health Organization

The ***World Health Organization (WHO)*** is an agency of the United Nations that was founded in 1948. Its purpose is to promote good health for all people of the world through the direction and coordination of international health work. WHO offers services in training health workers, controlling disease, improving the health of mothers and children, working toward better sanitation, and encouraging good mental health. One of the primary functions of WHO is to prevent disease through effective health systems.

WHO currently has approximately 165 member nations. It is governed by the World Health Assembly, which is made up of delegates from all the member countries. The section of WHO responsible for examining the program plans and the budget is known as the executive board. The World Health Assembly selects twenty-four countries to appoint a delegate to the executive board. The executive board also is responsible for investigating any situation requested by the assembly. The third part of the WHO is known as the secretariat. The secretariat is headed by a director general and is made up of all WHO workers around the world. The organization's headquarters is in Geneva, Switzerland, and there are six regional offices throughout the world. Figure 7.2 lists the program goals for the organization.

Program Goals of the World Health Organization (WHO)

1. Development and testing of methodologies for integrating nutritional objectives into national development plans
2. Development and testing of methodologies for establishing nutrition monitoring and surveillance systems as a basis for action programs and for their evaluation
3. Integration of nutrition activities primarily within maternal and child care, as a component of primary health care
4. Promotion of and collaboration in measures for the control of endemic goiter
5. Further development, and the testing under varying conditions, of methods for control of vitamin A deficiency and nutritional anemia
6. Promotion and support of further studies needed for a better understanding of factors responsible for malnutrition and related problems
7. Collaboration in training health workers in nutrition

Figure 7.2

Food Assistance Organizations in the United States

Many organizations provide food assistance for hungry people in the world. In the United States, federal food programs were organized to decrease the incidence of hunger and malnutrition in the country. Other privately funded organizations work to meet the needs of hungry citizens in communities across the United States. As the developed countries of the world realized the magnitude of the world hunger problem, food assistance programs were organized to provide aid to developing countries.

U.S. federal food programs are programs administered by the Food and Nutrition Service of the United States Department of Agriculture. Government assistance for farmers or for those suffering from hunger and malnutrition did not begin until after the Great Depression of the 1930s. Food assistance programs actually began with the first federal food stamp program in 1939. This first program was very complex and was abandoned in 1943. The food stamp program that now exists was started in 1961 during the Kennedy administration. In the late 1960s, research studies showed such an enormous incidence of hunger and malnutrition in America that the food stamp program was expanded and other food assistance programs were begun. Various federal food assistance programs in the United States are described as follows:

- ***Food Stamp Program***
  This program provides food stamps for low-income families. The food stamps may be used at grocery stores to purchase food items. There are restrictions on which items may be purchased. Criticisms of the food stamp program include the argument that food stamp recipients do not always purchase nutritious food items and that the program is not administered efficiently. The Food Stamp

Act of 1977 helped to alleviate some of these problems.

- ***School Lunch Program***
  The National School Lunch Program was started in 1946. This program allows public and private schools to provide nutritious lunches for school children at a low cost. The school lunch programs are subsidized, and economically disadvantaged children can receive lunch free or at a reduced price. The school cafeteria must abide by federal nutritional guidelines that require that the meal provide one-third of the Recommended Daily Allowance (RDA) for certain nutrients.

- ***School Breakfast Program***
  The school breakfast program was established in 1966 under the Child Nutrition Act. This program was designed to work with the school lunch program to provide children with two-thirds of the RDA for certain nutrients. Although not as many children participate in the school breakfast program as the school lunch program, the program has been considered successful because of the improved nutritional status of the children who have been involved in the program.

- ***Women, Infants, and Children (WIC) Supplemental Food Program***
  The WIC program was established in 1970 to provide health education, nutritional supplements, and preventive health care to women, infants, and children up to age five. Participants in the program must not only be economically disadvantaged but also considered nutritionally deficient. The WIC program has been successful in reducing infant mortality, low birth weight, and complications associated with pregnancy.

- ***Title III Nutrition Program for the Elderly***
  This program was started in 1972 in response to research that showed a correlation between people who lived alone and inadequate nutrition. The purpose of the program is to help senior citizens living alone by providing nutritional lunches served at a central location. The meals are provided free of charge to anyone over age fifty-nine. Participants who wish to pay for their meals may do so. Transportation is provided. This program not only provides nutritionally balanced meals for senior citizens, it also provides a place for social interaction. Through well-balanced meals and a social atmosphere, this program contributes to the physical, emotional, and social well-being of older adults.

- ***Commodity Food Distribution Program***
  Surplus foods are distributed through the USDA. ***Commodity foods*** are surplus food products that are stored as a result of farm price support programs. These surplus food products are distributed to low-income families and elderly citizens on fixed incomes.

- ***Expanded Nutrition Program***
  The Expanded Nutrition Program is a federally funded nutrition education program for low-income families. This program is administered by the Cooperative Extension Service in each state. Expanded nutrition staff members work with homemakers in small groups to teach nutrition, food buying, and food preparation skills. Most of these homemakers use commodity foods that they

receive from the Department of Human Services. The Expanded Nutrition Program also offers a youth program that teaches young people nutrition education and food preparation skills. On the federal level, this program is referred to as the Food and Nutrition Education Program. On the state level, the program is called the Expanded Nutrition Program. Most of the Expanded Nutrition Programs are in large urban areas.

Food Assistance Programs in Other Countries

Many food assistance programs provide food to people in needy countries of the world. The food aid given to other countries by the United States is organized and administered by the Food for Peace program. The ***Food for Peace*** program provides farm products from the United States to developing countries such as those in Africa, Asia, or Latin America. Most of these products are commodity products such as grain or grain products. Sometimes the food products are sold; other times the food is donated. The USDA directs the Food for Peace program. The secretary of agriculture decides which products are available to be exported to the countries in need.

The UN and the FAO sponsor the World Food Program. The ***World Food Program*** accepts donations from developed countries throughout the world and then distributes the food to the countries in need. Many private charitable organizations in the world work to supply food and agricultural assistance to countries with a limited food supply.

NUTRITION AND WORLD PROGRESS

There is enough food produced to feed all the people of the world. Food assistance organizations offer aid, but there are still approximately 520 million hungry and malnourished people in the world. In order to understand why, it is important to investigate the world hunger problem. It is also necessary to examine world food trade policies and how they impact the problem of worldwide hunger and malnutrition. Figure 7.3 illustrates where the hungry people of the world live.

The World Hunger Problem

The problems of world hunger cannot be attributed to any one cause or factor. Chapter Six discussed the factors that were related to the world food supply. Thus, many of the same factors relate to the causes of world hunger. Sociologists and scientists agree about the factors that contribute to malnutrition and hunger in the world. These factors include the following:

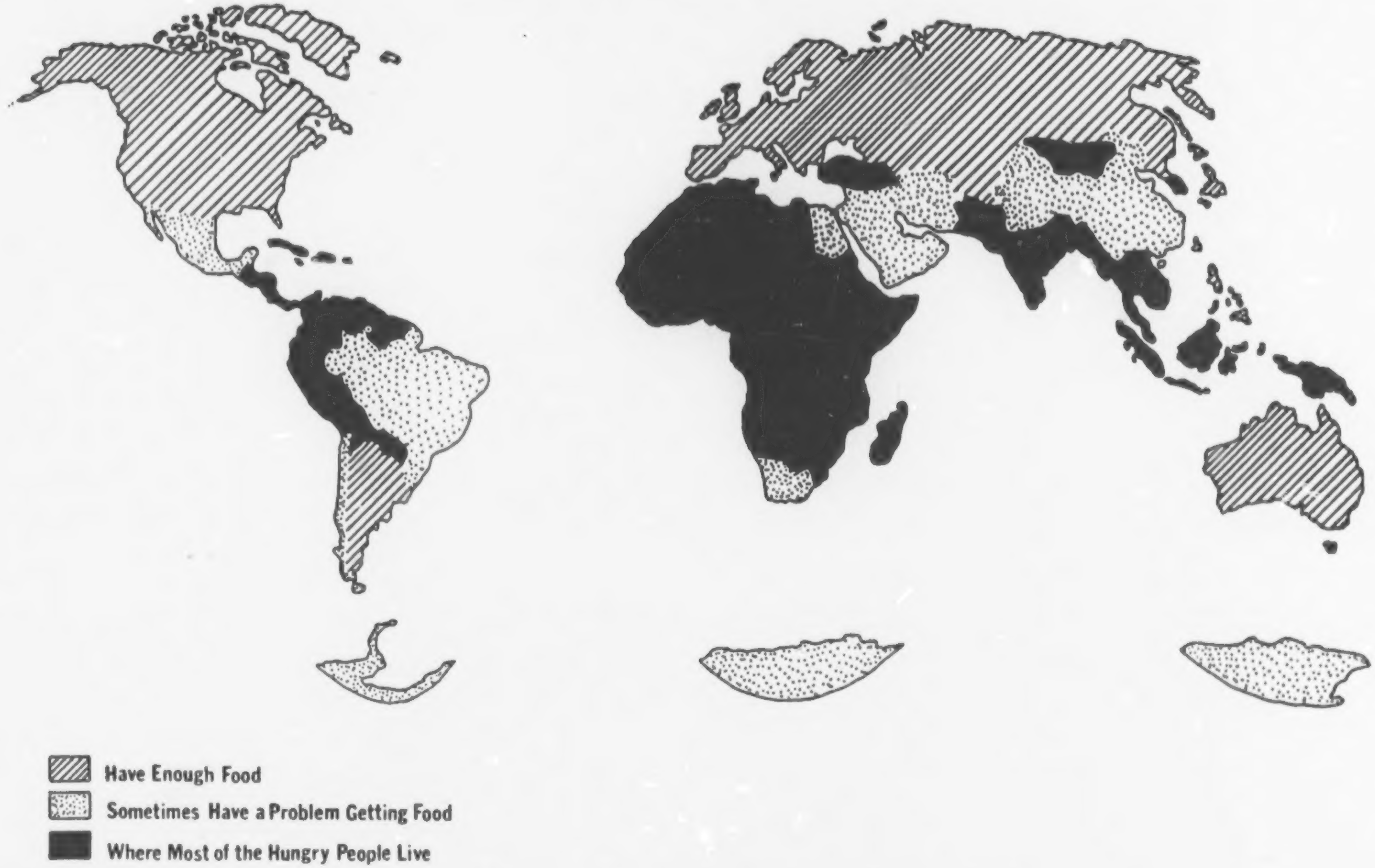
- cultural and religious food issues
- disasters
- food reserves insufficient in densely populated countries
- inequality of food supply and demand
- insufficient water supplies
- lack of adequate nutrition and health information and education
- poverty
- soil erosion
- war and political unrest

All of the causes of hunger and poverty are intertwined. Combined with all the factors listed is the fact business and governments control the management of the economies of the nations in the world. Decisions affecting world food issues are made by these two powers. Figure 7.4 lists facts that illustrate the reality of world hunger today.

Solutions

Leaders of the world continue to look for solutions to the world hunger problem. When the total problem is broken down into smaller problems, the possibilities for solving the problems seem more attainable. Many programs have made advances in solving some of these problems. A protein-rich flour called Bennimix was developed in Sierra Leone in West Africa to supplement the diets of infants and children. ***Bennimix*** is a flour made from

FEEDING A HUNGRY WORLD


▨ Have Enough Food
░ Sometimes Have a Problem Getting Food
■ Where Most of the Hungry People Live

Source: "The Problem of World Hunger," *The Social Studies Journal*, Global Perspectives in Education, Inc., July/August 1983. Reprinted by permission of the publisher.

Figure 7.3

Facts About World Hunger

- Each day, 60,000 people die of hunger– 40,000 are children under age five.
- Four times more malnourished children are female than male.
- In cereal grain alone, the world already produces enough to supply 3,000 calories per day for every man, woman, and child. More than half of it is grown in the Third World, but much of it is exported.
- Just 1/2000 of the world's grain harvest could nourish all those who die of hunger and related causes.
- The only area of the world where per capita food production is *not* increasing is Sub-Saharan Africa.
- Since 1970, there have been major famines in seven out of the eleven countries of southern Africa: Angola, Lesotho, Mozambique, South Africa (a famine affecting blacks only), Swaziland, Tanzania, and Zimbabwe.
- Of the world's poorest forty countries, thirty-six export food to North America.
- User fees for health care and education in developing countries help ensure that rich children grow up healthy and literate while poor children remain sickly and illiterate.
- Every minute, thirty children die for want of food and inexpensive vaccines, while every minute, the world's military budgets absorb $1.7 million of public funds.
- About a quarter of Africa's population– more than 100 million people– do not consume enough food to support an active working life.
- Landless laborers work on large plantations that produce bananas, sugar cane, cocoa, beans, and coffee– all for export. In Guadeloupe, 66 percent of the arable land produces export crops.
- Peasants in Third World countries pay rent by giving as much as 75 percent of their harvest to their landlords.
- In Southern Africa, life expectancy at birth is less than 50 years (includes Mozambique, Malawi, Angola, and Namibia).

Source: *World Hunger Facts*, available from Oxfam America.

Figure 7.4

rice, benniseed (a variety of sesame seed), and peanuts. Malnourished children began to thrive when Bennimix was added to their diets. In Nepal, a similar product was created by mixing soybeans, corn, and wheat. This "superflour" was used to make porridge, which was fed to malnourished children and their mothers. After ten days of supplementing their diets with the porridge, the mothers and children had gained weight, and their overall general health was improved.

The United Nation's Children's Fund (UNICEF) has developed a plan for reducing the number of child deaths from hunger and malnutrition. This plan is part of UNICEF's Child Survival campaign entitled GOBI. ***GOBI*** is an acronym for the four parts of the child survival campaign. These parts include growth charts, oral rehydration therapy, breast milk, and immunizations. The four areas have been identified as critical to this program. The growth charts are given to mothers with children in developing countries and in some parts of the United States. The mothers are taught to weigh their children every month and to detect the early signs of malnutrition that can cause retarded growth, development, and death.

The oral rehydration therapy (ORT) was developed to counteract the damaging effects of starvation and malnutrition. These children do not actually die from hunger or malnutrition but from the severe health problems these conditions create. The children suffer from severe diarrhea caused by bacteria and infections. The diarrhea causes dehydration, which leads to life-threatening health problems. The ***oral rehydration therapy (ORT)*** consists of giving the children a solution of salt, sugar, and water that mothers can prepare. The mothers are taught the proper proportions to use. This solution counteracts the weakening effects of the diarrhea.

Breast-feeding is being promoted in developing countries because of its many important health benefits. Breast milk is sterile and nutritious and provides the infant with important immunities. UNICEF's efforts to provide children with immunizations against diseases such as diphtheria, measles, polio, tetanus, tuberculosis, and whooping cough will certainly have an effect on the child mortality rate in developing countries.

The ***Presidential Commission on World Hunger*** in 1978 brought global attention to the issues involving world hunger. The members of this commission recognized that actions to overcome hunger and malnutrition in the world must be aggressive. Figure 7.5 lists some of the conclusions that were drawn from that study.

Presidential Commission on World Hunger

- The major world hunger problem today is the prevalence of chronic undernutrition, which calls for a political, as well as a technical, solution.
- The world hunger problem is getting worse rather than better.
- A major crisis of global food supply—of even more serious dimensions than the present energy crisis—appears likely by the year 2000, unless steps are taken now to facilitate a significant increase in food production in the developing nations.
- The rising global demand for food must be met within resource limits of land, water, energy, and agricultural inputs.
- There is no ideal food, no perfect diet, no universally acceptable agricultural system waiting to be transplanted from one geographical, climatic, or cultural setting to another. Assistance programs must focus on self-reliance and respond to the needs of each country. Needs and requirements cannot be generalized.
- In addition to action by the industrialized nations, decisive steps to build more effective national food systems must be taken by the developing countries.
- The outcome of the war on hunger, by the year 2000 and beyond, will be determined not by forces beyond human control but by decisions and actions well within the capability of nations and people working individually and together.

Source: Adapted from the Report of the Presidential Commission on World Hunger, *Overcoming World Hunger: The Challenge Ahead*, (Washington, D.C.: U.S. Government Printing Office, 1980) pages 180-185.

Figure 7.5

Many different organizations work with food policy issues. Some of these agencies and their mailing addresses are listed. These agencies provide factual information about the current status of world food policies and related topics. The following are world hunger agencies:

- Bread for the World
- Food Research and Action Center
- The Hunger Project
- Oxfam America

WORLD FOOD TRADE POLICIES

As part of the study of world hunger and food policy issues, it is important to understand the role of world food trade policies. Although worldwide trade has grown rapidly since 1900, the leading exporting countries have virtually remained the same. The top three leading exporting countries include the United States, West Germany, and Great Britain. The top fifteen leading exporting countries export about 70 percent of the total world exports. These same countries also seem to be the world's largest producers.

A large volume of the trade between countries occurs with countries in the same geographic region. For example, approximately two-thirds of Canada's exports go to the United States, and in turn, Canada is one of the United States' largest customers of exports. This same pattern exists in western Europe and in the communist countries.

Nations are free to establish their own regulations regarding foreign trade. However, in 1947 the ***General Agreement on Tariffs and Trade (GATT)*** was signed by twenty-three countries. The GATT is an agreement that allows for a nondiscriminatory approach to world trade policies. Each country's trade problems and conflicts are worked out cooperatively with the other participating nations.

Most of the developed or industrialized nations try to protect their agricultural products from foreign imports. This is a way of encouraging domestic production. The United States is a large exporter of food products because it is also one of the world's largest producers. Figure 7.6 lists facts about U.S. food trade.

United States Food Trade

☆ Although farm output makes up only 3 percent of the U.S. Gross National Product (the total value of the U.S. annual output of goods and services), it provides nearly 25 percent of its exports.

☆ Developing country imports of food from the United States rose from $2 billion to almost $10 billion in the past decade.

☆ More than half the grain that crosses international borders is from the United States.

☆ More than half of U.S. wheat exports and nearly three-fourths of rice exports go to the developing world.

☆ The United States provides 46 percent of the world's wheat exports and 25 percent of the world's rice exports.

Source: Report of the Presidential Commission on World Hunger, *Overcoming World Hunger: The Challenge Ahead*, Washington, D.C.: Government Printing Office, 1980.

Figure 7.6

Summary

- It is now believed that the cause of hunger and malnutrition is poverty.
- The FAO works primarily in developing countries to improve agricultural production, use of soil and water resources, nutrition, and agricultural technology.
- The purpose of the World Health Organization is to promote good health for all people of the world through the direction and coordination of international health work.
- One of the primary functions of the WHO is prevention of disease through effective health systems.
- In the United States, federal food programs were organized to decrease the incidence of hunger and malnutrition in the nation.
- The food aid given to other countries by the United States is organized and administered by the Food for Peace program.
- The USDA directs the Food for Peace program.
- A large volume of the trade between countries occurs with countries in the same region.

Vocabulary

Bennimix
Commodity Food Distribution Program
commodity foods
Expanded Nutrition Program
Food and Agriculture Organization (FAO)
Food for Peace
Food Stamp Program
General Agreement on Tariffs and Trade (GATT)
GOBI
oral rehydration therapy (ORT)
poverty
Presidential Commission on World Hunger
School Breakfast Program
School Lunch Program
Title III Nutrition Program for the Elderly
U.S. federal food programs
Women, Infants, and Children (WIC) Supplemental Food Program
World Food Program
World Health Organization (WHO)

Review

1. List the goals of the organizations that work toward finding solutions to the world hunger problems.
2. What are the purposes of the FAO?
3. What services are offered by WHO?
4. Explain the history of the U.S. federal food program.
5. Which agency organizes and administers the food aid given to other countries by the United States?
6. Name the sponsors of the World Food Program.
7. If there is currently enough food produced to feed all the people of the world, why are there still so many hungry people?
8. List the factors that contribute to hunger and malnutrition in the world.
9. What are some of the advances that have helped solve hunger problems in parts of the world?
10. Summarize the conclusions that were drawn from the 1978 Presidential Commission on World Hunger.
11. How is world trade related to world hunger?
12. Why do developed countries want to protect their agricultural products from foreign imports?

Critical Thinking

Explain how the long-term effects of hunger can affect a society. Relate issues such as health, education, and distribution of income to the long-term effects of hunger. What other issues are involved? What are some possible solutions to the problems of world hunger?

8

Scientific and Creative Aspects of Food Processing and Marketing

ESSENTIAL ELEMENT

- ☐ Summarize the scientific and creative aspects of food processing and marketing.(j2A)

OBJECTIVES

- ☐ Analyze technological advances in food processing.
- ☐ Describe new trends in food product development.
- ☐ Explain how creative marketing techniques are used in the food industry.

TECHNOLOGY IN FOOD PROCESSING AND MARKETING

Technology is the combination of techniques and tools or instruments that permit a person to accomplish a task. Thus, ***food technology*** is the application of the fundamentals of chemistry, biology, physics, and engineering to the problems of food preservation, including product development. The many new food products that consumers find on the supermarket shelves are examples of advancements in food technology. Although consumers are always ready for new products that improve living standards, they are often skeptical about new food products. This skepticism is due to a lack of communication and education between food companies and consumers. Consumers need to understand some basic information about food science and technology in order to fully appreciate the advantages that advancements in food technology have brought to modern lifestyles.

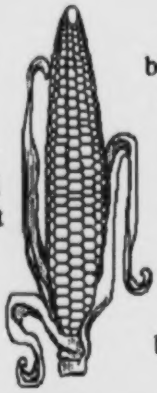
Biotechnology

In Chapter Six, biotechnology was defined as a science that uses technology, engineering, and knowledge of biological systems to develop and improve agricultural processes such as food production. Biotechnology uses living organisms to develop a new product. Cheese and yogurt are good examples of the use of living organisms in creating new products. Cheese and yogurt are made by the use of live bacteria in the fermentation process. In research laboratories around the world, biotechnology is responsible for many new innovations in food science. Biotechnology has made possible some new products that may soon be available. Consumers may soon see products such as beef with less saturated fat, more calcium-rich dairy products, and disease-resistant plants.

The difference between biotechnology and procedures that have been used in the past is genetic engineering. Genetic engineering allows scientists and food technologists to cross species barriers to select one gene or trait in an organism and use it to develop a better, more efficient organism. Biotechnology makes breeding of living organisms a more flawless, predictable process.

Biotechnology will most greatly affect the food supply through agricultural production. New advancements include development of plants with disease resistance, herbicide resistance, insect tolerance, and virus resistance. These new developments will increase agricultural yields and decrease the use of pesticides.

Food technologists and agricultural specialists are experimenting with changing the properties of some fruits and vegetables to create a more desirable product. For example, research includes developing a tomato that is more flavorful and more solid that can vine-ripen without rotting. Another example is the improvement of the quality of corn by manipulating one or two genes that will increase the level of essential amino acids.



Another area where biotechnology is being used is waste management. Developing new ways to efficiently use food waste products is a must. For example, it takes ten pounds of milk to make one pound of cheese. The product left over after the cheese is made is known as whey. For a long time, whey was sprayed onto the soil to be broken down by the bacteria in the soil and absorbed. However, now soil is saturated and a new use for the whey must be found. The Japanese have used genetic engineering to develop a yeast from the whey. They use this genetically engineered yeast to make hepatitis B vaccine. The hepatitis B vaccine protects people from the hepatitis B virus. Hepatitis B is a very serious viral liver infection. Thus, the Japanese have taken food waste and created a valuable medicine. Biotechnology is going to be beneficial in creating new uses for food waste in the future.

Food Fabrication

Food fabrication is the formation of an imitation or fake food product that resembles real food. A good example of a fabricated food product is surimi. ***Surimi*** is an imitation seafood product made from inexpensive fishes, primarily pollock. The fish is deboned and then puréed to form a paste. Puréeing is a method of converting a food to a paste or thick liquid by forcing the food through a sieve or using a food processor. The puréed product is mixed with other ingredients such as egg whites, starch, wheat flour, flavorings, and preservatives and is then shaped to resemble lobster, crab meat, shrimp, or scallops.

This product is very versatile because it can be shaped and frozen into any form. Although surimi was first introduced into the United States in the late seventies, the Japanese have been using it as a dietary mainstay for 900 years. The Food and Drug Administration (FDA) considers surimi to be a "wholesome and nutritious product." However, many consumers may be misled to believe they are eating the real shellfish because surimi is often labeled as "seafood."

Aspartame is another fabricated food substance. ***Aspartame*** is an artificial sweetener that is marketed as NutraSweet when used as a food additive and as Equal when used as a table sugar substitute. Aspartame loses its sweetening ability when heated, so it is not satisfactory for cooking or baking. However, aspartame can withstand the mild temperatures of warm beverages. It cannot be used by people with PKU (phenylketonuria) because their bodies cannot metabolized phenylalanine, one of the amino acids in aspartame. PKU is an inherited deficiency of the enzyme that metabolizes phenylalanine in the liver. Without treatment, PKU leads to brain damage and severe mental retardation. Although there was much controversy concerning FDA approval of aspartame, it has now passed FDA approval twice and is considered safe for consumer use.

The newest artificial sweetener to receive FDA approval is acesulfame-K. ***Acesulfame-K*** is a chemical compound that is combined with dextrose, cream of tartar, and flavorings to form an artificial sweetener marketed as Sunette or Sweet One. This product has the advantage of retaining its sweetening capabilities in cooking and baking. Other new artificial sweeteners that have been developed but await FDA approval at this time include Lev-O-Cal and stevioside. ***Lev-O-Cal*** is an artificial sweetener that resembles real sugar in taste and appearance. It is calorie-free because it is not absorbed by the body. Lev-O-Cal can be used successfully in cooking and baking because it is not broken down by heat. ***Stevioside*** is a natural sweetener that has been used in Brazil and Japan for many years. It is made from the leaves of a South American plant and is 250 to 300 times sweeter than sugar. Stevioside is calorie-free and can be used in place of sugar in food preparation.

Texturized vegetable protein is a protein product used to make food products that resemble meat, fish, or poultry in taste and appearance. Soybean products are most often used for this purpose because they can be made to look like many other foods. One of the most common uses of texturized vegetable protein is as a filler in meat products. An example of a product made from soybean proteins is the artificial "bacon chips" sold in the supermarket.

Food Production and Processing

Advances in food technology bring new products to the supermarket shelves. For many years, consumer demands included mostly convenience products that saved time and energy in preparation. The increased concern and awareness of the relationship between diet and health has changed consumer demand. The American consumer not only wants new food products that are easy to prepare yet taste like homemade, they also want food products that offer good nutrition and fewer calories. The new health and weight conscious Americans have challenged the food industry to meet their demands with new food products that fit these requirements. It is the job of food technologists to create and modify food products to meet this consumer demand.

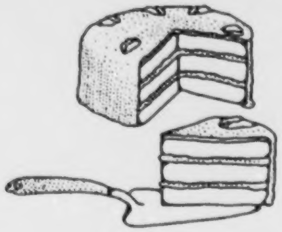
New advancements in the field of food technology include the innovation of new fat substitutes. Since excessive fat intake has been linked to coronary heart disease, atherosclerosis, strokes, and some cancers, health conscious consumers are searching for products that supply the satisfying taste and texture of fat in foods without the negative effects. Two new fat substitutes created by food technologists include Simplesse and Olestra.

Simplesse is a fat substitute made from milk and egg white protein. It contains about two calories per gram compared to the nine calories per gram in normal fats. Simplesse is made by heating and blending the protein into tiny particles that resemble the taste and texture of fat. These tiny particles create a sensation of creaminess just as fat does. Presently, Simplesse is used in a frozen dairy product that resembles ice cream. Simplesse cannot be used in cooked products because the addition of heat causes the product to lose its creaminess.

Another new fat substitute recently developed is olestra. ***Olestra*** is a calorie-free fat substitute made from a combination of vegetable oils and sugar known as sucrose polyester. The Olestra molecules are so large that they are not digested or absorbed in the body. In cooking, Olestra performs like regular fats because it is mostly fatty acids from vegetable oils. Olestra is awaiting FDA approval for consumer and commercial use. Other fat substitutes that can be used in cooking and frying are currently being developed.

Many other new food products are results of advancements made in food technology. The "juice box" has been acclaimed as one of the most significant food science innovations in fifty years. The reasons behind this commendation by food safety and nutrition experts are the aseptic packaging, processing technique, and convenience. Some of the other new innovations from food technology include controlled-atmosphere packaging for fresh fruits and vegetables, freeze-drying, frozen concentrated citrus juices, frozen meals, improved understanding of water activity in foods, nutrient fortification, and pasteurization of dairy products through ultra-high temperatures.

A new high-fiber ingredient currently being researched is fluffy cellulose. ***Fluffy cellulose*** is a derivative of citrus pulp, sugar beet pulp, and wheat straw that has the capabilities of a flour substitute. Fluffy cellulose contributes no calories because cellulose cannot be absorbed or digested by humans. This product is being tested as a substitute for part of the flour in cakes. Cakes made with fluffy cellulose are more moist and bake up larger than cakes made with 100 percent regular wheat flour. The use of fluffy cellulose reduces the calorie content of the cakes by approximately 10 to 20 percent.



Artificial refers to food products or ingredients that are imitations or substitutes for natural food items. A ***fortified*** food is a food to which nutrients that were never present originally have been added to improve the nutritional value of the food product. An example is milk that has been fortified with vitamin D. An ***enriched*** food is one to which the nutrients that have been lost in processing are added to the food in amounts equal to those originally present or in increased amounts. Examples of enriched food products include breads, cereals, and some flours.

Formulated foods are food products developed to supplement diets and feeding programs for people who are malnourished or suffering from some nutritional deficiency. One of the most well-known formulated foods was ***Incaparina***, a mixture of corn and cottonseed flour used as part of a supplemental feeding program in Central America and Panama.

Meat analogues or meat replacements are food products made from plant proteins that have been shaped and formed to resemble meat products. Meat analogues are made of textured vegetable protein and imitate meat products in appearance, taste, and texture. Some meat analogues are made from ***tofu***, a cakelike product made from soybeans and water. Tofu has been used as a protein source by the Japanese since it was first introduced by Buddhist monks in the twelfth century. Meat analogues are popular food choices because they have a low fat content and are generally less expensive than their real meat counterparts.

Synthetic foods are manufactured food products that are made from artificial chemicals that resemble those naturally found in foods. All food is made up of chemical compounds. Food technologists and scientists have been able to analyze the chemicals found naturally in food and duplicate them in the laboratory. Often, the synthetic food product may be superior to the natural food because some of the toxic substances that naturally occur in food can be omitted. The human body cannot distinguish between synthetic foods and real food because the molecular structure of the synthetic ingredients correspond to those found in natural foods. An example of a synthetic product is vitamin tablets. Vitamin tablets have the exact chemical components as the vitamins that occur naturally in food.

Many synthetic foods are manufactured using plant and animal sources in nonconventional ways. For example, infant formulas are made from a variety of ingredients, such as soy milk, in an effort to duplicate breast milk. Most synthetic foods have the same nutritional value as the natural foods they imitate. Many synthetic foods are fortified during the manufacturing process to increase the nutritive value. The benefits of synthetic foods include longer shelf life, lower cost, and unlimited availability to the consumer.

Packaging

Packaging is the final step in the processing of food products. Not only does packaging protect foods from damage, it also protects foods from spoilage due to bacteria, heat, light, and oxygen. Packaging also shields foods from the damaging effects of insects and other pests.

From a marketing standpoint, eye-catching packages increase sales. Besides protecting food from damage or spoilage, many foods are packaged according to how they will be used. For example, many frozen convenience foods are packaged in boil-in-bags or plastic trays that allow for easy food preparation. These foods may be cooked right in the package. In this era of dual-career families, this type of packaging has been a successful marketing tool because of the added convenience. Other packaging techniques include resealable plastic bags and plastic or glass containers with snap-on or screw-on lids. Figure 8.1 lists some new advancements in packaging technology.

All of these new packaging technologies add cost to the price of the food. It is estimated that eight cents of every American food dollar goes for packaging. Paperboard boxes and food containers represent the largest packaging cost. Approximately 20 percent of packaging costs are for plastic products.

PRODUCT DEVELOPMENT

As lifestyles change and Americans become more health conscious, food choices and eating patterns change. These changes have a great effect on the food industry. Consumers are demanding food products that combine taste, texture, and appearance with convenience and good nutrition. These factors produce an ongoing challenge for the food industry. Food technologists continuously work on product development. These efforts enable the American consumer to have the most abundant food selection in the world. The current trends in product development are food products that meet the needs of Americans who are health conscious, dieting, and busy.

New Products for the Health Conscious Consumer

Information on health-related issues and the relationship of diet and health is available to anyone who is interested. Consumers are more knowledgeable than ever before on topics related to diet and health. Even though some of the information consumers hear and read is not factual or based on research, the emphasis on a healthier society has increased awareness and changed public attitude toward nutrition.

Packaging Technology

- **Aseptic packaging**
  Foods are sterilized and then packaged in sterilized aseptic containers such as laminated paper and foil cartons, plastic bags, and plastic cups. Aseptically packaged food can be stored without refrigeration. Aseptic packaging is sterile and prevents the growth of harmful microorganisms.
  Example: fruit juice boxes
- **Retort pouch**
  Food is sealed in the package before it is processed. After opening the package, only heating is required. It has an indefinite shelf life.
  Example: main course entrees that require no refrigeration
- **High-temperature Short Time (HTST) aseptically packaged milk and milk products**
  HTST is a pasteurization process that uses highly controlled heating of the milk for a short time. This process kills harmful microorganisms and also deactivates the enzymes that cause bitterness without affecting the flavor of the milk. Milk is packaged in sterilized (aseptic) laminated paper cartons or opaque plastic bottles.
  Example: fluid milk and milk products
- **Modified atmosphere packages for meat, fish, poultry, fruits, and vegetables**
  This process involves packaging these products in an atmosphere with a high concentration of carbon dioxide. The carbon dioxide retards the growth of microorganisms that causes spoilage and mold. This process greatly extends the shelf life of these foods.
  Example: cooked meats and bacon
- **Film**
  This includes perforated film, opaque film, or vacuum-packed and nitrogen backfill packages for luncheon meats.

Figure 8.1

The emphasis on lowering fat and cholesterol for a healthy heart has brought many new products to the supermarket shelves. Even though margarines are predominantly fat, the saturated fat and calorie content vary greatly from product to product. New products on the market have as few as three grams of fat per tablespoon with only half a gram being saturated fat.

Consumer demand for foods with lower fat content has challenged the beef industry to develop new breeds of cattle that produce a leaner beef product. Changes in grazing practices and crossbreeding have produced beef with less marbling (small pieces of fat scattered throughout the lean muscle of meat) and consequently less fat. Cattle are spending one-third less time in the feedlot in an effort to produce a leaner variety of cattle. Industry standards also have allowed the supermarket butcher to trim more fat from meat.

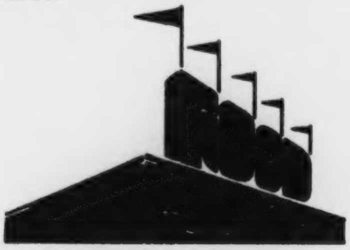
With the increased demand for lower fat and leaner meat products, the turkey industry has seen a dramatic increase in sales and pressure for development of new turkey products. Turkey is a wise meat choice because it is lean, low-fat, versatile, and less expensive than beef or pork. Manufacturers have used turkey to create counterpart products such as turkey ham and turkey pastrami.

Another health issue that has brought many new products to the supermarket is the emphasis on a high-fiber diet. Oat bran received so much attention as a high-fiber product that would lower cholesterol that the supermarket shelves became flooded with products made with oat bran. Since then, consumers have learned that other foods have high amounts of soluble fiber as well. Although soluble fiber is known to help lower cholesterol, no one food alone can prevent heart disease or any other health problem. The lifetime practice of healthy eating and exercising reduces a person's risk of developing diet-related diseases. The oat bran issue did succeed in increasing public awareness of the importance of a low-fat, high-fiber diet.

New Products for Convenience

The typical American family now involves either a dual-income couple or a single working parent. This lifestyle change has brought about an increased demand for convenience food products. One area of new product development is the frozen, microwavable breakfast entree. Although most of these products are high in fat and sodium, they require only microwave heating and are packaged in disposable trays. The frozen food industry has been a leader in developing new convenience food products. Consumers can stroll down the frozen food aisle of the supermarket and choose a complete dinner or individual servings of meat dishes and vegetable combinations. Among the choices are any number of foreign foods as well as fancy desserts in individual servings.

The emphasis on increased consumption of complex carbohydrates for healthy eating has brought new attention to pasta and rice dishes. The food industry has introduced a vast selection of prepared pasta sauces that can be heated and served. Many pasta sauces are sold with meat as an ingredient. Since preparation of the pasta only involves boiling in water for a short time, these products have become popular convenience items. Consumers will continue to see new products at the supermarket that meet the demands of taste, appearance, nutrition, and convenience.



CREATIVE MARKETING TECHNIQUES

Marketing is all of the activities involved in getting goods from the seller to the buyer including advertising, selling, storage, and transportation. Food marketing involves many people. ***Food brokers*** are sales representatives employed by food brokerage firms. They contract sales of grocery products between manufacturers and retailers without actually handling the product. ***Food wholesalers*** purchase products directly from manufacturers and store them in warehouses until the products are sold to retail outlets.

Retail outlets are the markets that sell to the consumer, such as supermarkets and small grocery stores. Retailers may purchase grocery products directly from a manufacturer's sales representative or from a food broker. Many retailers purchase some products from both. Large supermarket chains purchase products directly from the manufacturer and warehouse them for distribution to their stores. An enormous network of people from the processing plant to the airlines, railways, and trucking industry work to provide the thousands of food items that are available in the supermarket. Figure 8.2 lists different ways products can be marketed.

Ways Products are Marketed

- **Through the choice of a name for the product**
- **By developing a product which is very convenient or very useful**
- **By packaging that is appealing in form and color**
- **Through labeling that is informative and readable**
- **By pricing the product so that is competes successfully with other brands**
- **By conducting marketing surveys and planning a strategy for introducing the product to the market**
- **Through an effective advertising campaign**

Figure 8.2

New Trends in Marketing Food

As a result of the changing population, the ways food is marketed to the consumer have changed. Cities now have ***hypermarkets*** where consumers can buy a variety of things including shaving cream, houseplants, gourmet items, seafood, or exotic produce. These hypermarkets have mini-hothouses (greenhouses) where customers can watch fresh tomatoes and other produce growing on the vine.

Other supermarkets offer ***warehouse shopping*** where shoppers can buy quantity items at a lower cost. Some food stores even offer gourmet boutiques. The ***gourmet boutique*** prepares gourmet meals for takeout. Some even offer dinner with a movie, which includes the gourmet dinner, a rental videocassette recorder (VCR), and a movie rental.

Competition among retailers has added a new interest in special services at the supermarket. Many supermarkets have in-house nutritionists and in-house chefs to aid consumers in making food buying decisions. Along with these services, consumers can find takeout food; mail service; tax advice; and fresh, ready-to-cook foods such as pork roast with stuffing, shish kebabs, or prepared salads. The supermarket shopper of today can truly buy everything from the food and flowers to the stemmed glassware for a candlelight dinner at home.

As sales of fresh and frozen foods increased, sales of canned foods dropped. In response, the manufacturers of canned vegetables have offered new products to regain some of the lost sales. First came the vegetables canned without added salt. Although sales of low-salt canned foods have been slow, the sales of canned foods in general are increasing. The most recent advance in canned products is the Veri-Green process. The ***Veri-Green process*** stabilizes the chlorophyll in vegetables and gives the product a better color, flavor, and texture. This is expected to be well received by consumers.

With the food industry offering the consumer choices from approximately 25,000 items in the supermarket, the demand for new and creative marketing techniques will continue to increase.

Summary

- Biotechnology uses living organisms to develop a new product.
- Genetic engineering allows scientists and food technologists to cross species barriers to select one gene or trait in the organism and use it to develop a better, more efficient organism.
- Biotechnology will most greatly affect the food supply through agricultural production.
- Developing new ways to efficiently use food waste products is a must.
- The increased concern and awareness of the relationship between diet and health has changed consumer demand.
- Health and weight conscious Americans have challenged the food industry to meet their demands with new food products that fit these requirements.
- New advancements in the field of food technology include the innovation of new fat substitutes.
- Many times the synthetic food products may be superior to the natural food because some of the toxic substances that naturally occur in food can be omitted.
- Packaging is the final step in the processing of food products. Not only does packaging protect foods from damage, it also protects foods from spoilage due to bacteria, heat, light, and oxygen.
- The current trends in product development are food products that meet the needs of Americans who are health conscious, dieting, and busy.
- The emphasis on lowering fat and cholesterol for a healthy heart has brought many new products to the supermarket shelves.

Vocabulary

acesulfame-K
artificial
aspartame
enriched
fluffy cellulose
food brokers
Lev-O-Cal
marketing
meat analogues
Olestra
retail outlets
Simplesse

food fabrication
food technology
food wholesalers
formulated foods
fortified
gourmet boutique
hypermarkets
Incaparina
stevioside
surimi
synthetic
technology
texturized vegetable protein
tofu
Veri-Green process
warehouse shopping

Review

1. How will biotechnology and genetic engineering affect the food supply? Give examples.
2. How can biotechnology be used in food waste management?
3. What are some advantages to fabricated foods?
4. What consumer demands have had the greatest effect on the food industry?
5. List the advantages of the new fat substitutes.
6. Why are some synthetic foods superior to the same natural foods?
7. What are the functions of packaging?
8. Which health issues influence product development in the food industry?
9. Explain the role of the food brokerage company.
10. How are products marketed?
11. Compare the new supermarkets of today with those of the past.
12. Summarize at least four new trends in marketing food.

Critical Thinking

Futurists forecast American lifestyles in the twenty-first century to be fast-paced, career-oriented, and family centered. Although both parents will be employed in most families, scheduling time for family activities will be a priority. What challenges does this lifestyle offer the food industry? What problems will arise for the food industry as a result of consumer demands in the next twenty-five years?

9

Safety and Sanitation

ESSENTIAL ELEMENT

- ☐ Outline safety and sanitation considerations for food processing and packaging.(j2B)

OBJECTIVES

- ☐ Analyze the factors involved in environmental and microbial contamination of food.
- ☐ Explain the HACCP procedure used by the food industry.
- ☐ Evaluate the responsibilities of the quality control department in a food processing plant.

Food safety is a topic of interest and concern for professionals in the food industry as well as for consumers. Most questions concerning food safety arise out of concern over a particular additive, environmental contaminant, or the presence of a dangerous microorganism such as botulism. Consumers need to be informed about food safety practices in food processing plants and in the home.

CONTAMINATION OF FOOD

Food is composed of many chemical compounds. All of the animal, fish, fowl, and plant products that people eat are made up of a variety of chemicals. Some of these chemicals contribute nutritional value to food, while others simply contribute color and flavor. All of these chemicals enter the human body through the consumption of food. However, some chemical substances of either natural or synthetic origin can contaminate food. ***Contamination*** occurs when food comes in contact with something that is impure or harmful and causes the food to be unsafe. Food can become contaminated by adulteration, growth of microorganisms, or exposure to some form of environmental contaminant. (Adulteration occurs when a harmful substance is added to the food that makes it unsafe.)

Environmental Contaminants

Environmental contaminants are hazardous chemicals that are found in food as a result of some environmental source. The two possible sources of environmental contaminants include the following:

1. The release of synthetic chemicals into the environment, especially into waterways
2. Contaminants found in the soil from natural sources such as geological formations

The Food and Drug Administration (FDA) has established regulations for acceptable levels of contaminants in food. The FDA continually monitors the food supply to ensure its safety. Refer to Chapter Five for additional information on FDA regulations of the food supply.

Microbial Contaminants

Microbial contaminants are harmful microorganisms that grow in food and can cause serious illness and even death. The hazards of food-borne illness can be avoided by sanitary food handling and effective food preparation techniques. To reduce the effects of contamination, the growth of microorganisms must be slowed by refrigeration or destroyed by heat. At temperatures between 40°F and 140°F microorganisms grow and multiply greatly in a very short time. To prevent microorganisms from growing and multiplying rapidly, food must be kept out of this danger zone.

At least one million people in the United States suffer from food-borne illnesses each year. Microbiological hazards account for the most cases of food-borne illness. ***Microorganisms*** are tiny living cells that can be seen only with a microscope. Microorganisms are everywhere—in the body, in the soil, in the water, and in the air. The four types of microorganisms that affect food are bacteria, viruses, yeasts, and molds. A microscopic view of types of microorganisms is shown in figure 9.1.

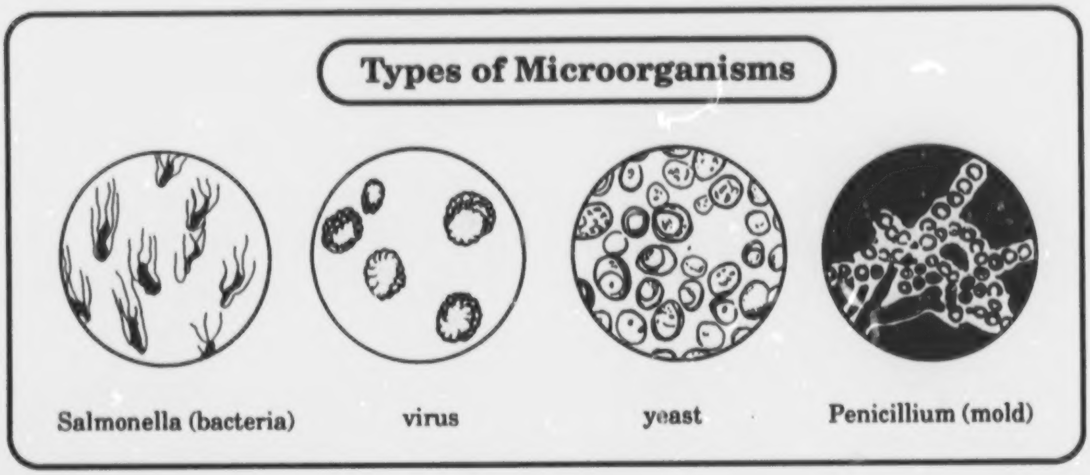


Figure 9.1

Food-borne illnesses caused by microbiological hazards are classified as either infections or intoxications. A ***food-borne infection*** is a disease caused by eating food containing harmful microorganisms. A ***food-borne intoxication*** is an illness caused by poisons or toxins in the food a person eats. The toxin may occur naturally in the food, as in certain mushrooms, or the food may be contaminated by toxins produced by certain microorganisms.

Bacteria are small, single-cell organisms that can live anywhere people can. They thrive in a warm, moist environment that is neutral or slightly acidic. Bacteria are more commonly involved in cases of food-borne illness than are viruses, yeasts, and molds. Common names of some food-borne illnesses of bacterial origin are staph, botulism, perfringens poisoning, salmonellosis, and listeriosis. The bacteria that cause the illnesses are *Staphylococcus aureus, Clostridium botulinum, Clostridium perfringens, Salmonella,* and *Listeria monocytogenes*.

Viruses are the smallest and perhaps the simplest form of life known. They cause illnesses such as colds, influenza, and infectious hepatitis. Unlike bacteria, viruses cannot grow and multiply on their own but must depend on a living host to reproduce. The living host is the organism in which another organism (such as the virus) lives for nourishment. For this reason, viruses do not increase in number while they are in food. The food merely transports the viruses, which may then lodge themselves in the human host and produce abundantly.

Viruses seem to vary in their reaction to heat and cold. The influenza virus is very sensitive to heat. Another type of virus has been shown to survive in food at temperatures as high as 176°F and remain active after storage in a refrigerator for more than one year.

Yeasts are fungi that require sugar and moisture for survival. Yeasts often consume these ingredients in food products and spoil the food in the process. Yeast organisms can be killed by heating to 136°F (56°C) for about fifteen minutes. In general, yeast spoilage can often be recognized by the presence of bubbles and an alcoholic smell or taste. Yeast spoilage can create a slime on fruit juices or pickle brine (the solution in which pickles are preserved) or a pink discoloration in cottage cheese. However, no evidence suggests that yeast-producing diseases in humans are transmitted by food or that yeasts occurring naturally in foods are harmful to humans.

Like yeasts, molds are fungi that may or may not be harmful to humans. ***Molds*** are furry-looking fungi that can grow on almost any food at almost any storage temperature, under almost any conditions—moist or dry, acidic or nonacidic, salty, or sweet. The color of mold is usually white but also can be blue-green, orange, black, gray, or even red. Certain molds produce toxins that have been known to cause cancer in animals. Spots of mold can be cut off the surfaces of some hard cheeses and firm vegetables. At least one inch should be cut off around and below the mold spot. Soft food items such as yogurt, sour cream, cheese slices, jams and jellies, tomatoes, and cucumbers with mold spots should be discarded.

Freezing prevents the growth of molds but does not kill those already present in food. Some molds give a musty odor and flavor to foods. Some people have developed allergies to certain molds. These allergies affect the sinuses, eyes, ears, and respiratory tract. Table 9.1 lists important information about food-borne illnesses.

HACCP SYSTEM

The ***Hazardous Analysis Critical Control Point (HACCP)*** concept outlines the quality control procedure used by the food industry in food production plants and food distribution outlets to identify possible sources of contamination in food substances. This system was developed by the food industry for use as a quality control tool. The hazard analysis part of the HACCP concerns identifying critical points

Illness	Bacteria Responsible	Description	Habitat	Types of Foods	Symptoms	Cause	Temperature Sensitivity
Staph	Staphylococcus aureus	Produces a heat-stable toxin.	Nose and throat of 30 to 40% of healthy population; also on skin and superficial wounds.	Meat and seafood salads, sandwich spreads, and high-salt foods.	Nausea, vomiting, and diarrhea within 4 to 6 hours. No fever.	Poor personal hygiene and subsequent temperature abuse.	No growth below 40°F. Bacteria killed by normal cooking.
Salmonellosis	Salmonella	Produces an intestinal infection.	Intestinal tracts of animals and humans.	High-protein foods—meat, poultry, fish, and eggs.	Diarrhea, nausea, chills, vomiting, and fever within 12 to 24 hours.	Contamination of ready-to-eat foods, insufficient cooking, and recontamination of cooked foods.	No growth below 40°F. Bacteria are destroyed by normal cooking.
Perfringens poisoning	Clostridium perfringens	Produces a spore and prefers low-oxygen atmosphere Live cells must be ingested.	Dust, soil, and gastrointestinal tracts of animals and humans.	Meat and poultry dishes, sauces, and gravies.	Cramps and diarrhea within 12 to 24 hours. No vomiting or fever.	Improper temperature control of hot foods and recontamination.	No growth below 40°F. Bacteria are killed by normal cooking, but a heat- stable spore can survive.
Botulism	Clostridium botulinum	Produces a spore and requires a low-oxygen atmosphere. Produces a heat- sensitive toxin.	Soils, plants, marine sediment, and fish.	Home-canned foods.	Blurred vision, respiratory distress, and possible death.	Improper methods of home-processing foods.	Type E and type B can grow at 38°F. Bacteria destroyed by cooking and the toxin is destroyed by boiling for 5 to 10 minutes. Heat-resistant spore can survive.
Listeriosis	Listeria monocytogenes	Survives adverse conditions for long time periods.	Soil, vegetation, and water. Can survive for long periods in plant materials.	Milk, soft, cheeses, and vegetables fertilized with manure.	Mimics meningitis. Immuno-compromised individuals most susceptable.	Contaminated raw products.	Grows at refrigeration (38°F to 40°F) temperatures. May survive minimum pasteurization temperatures (161°F for 15 seconds).

Adapted From: "Bacterial Food Poisoning," Al B. Wagner, Jr., Texas Agricultural Extension Service, The Texas A&M University System.

Table 9.1

such as sensitive ingredients or possible steps in processing that must be monitored to assure a safe food product. The critical control points are those steps in the food production process where quality control errors can result in an unsafe food product. Figure 9.2 shows the HACCP system.

The HACCP concept provides the food industry with a system of checks and balances that monitors the quality control procedures. Therefore, if something goes wrong, appropriate action can be taken and the problem can be resolved in a minimum amount of time.

QUALITY CONTROL

The major function of the quality control department is to monitor all the raw food

The HACCP System

The hazard analysis critical control point procedure consists of three hazard categories:

Category 1
Hazards caused by the ingredients in the unprocessed product

The food product may contain an ingredient or ingredients that could introduce potentially pathogenic organisms or toxins in food or that may have a flavor, color, or nutrient which can change during processing.

Category 2
Hazards related to the manufacturing process

The manufacturing process may not effectively destroy harmful bacteria; it may decrease the strength of any protective elements in the food which prevent contamination, or it interferes with the maintenance of quality in the food.

Category 3
Hazards caused by inadequate planning for storage and distribution

During the distribution process, the storage period, or in the handling by consumers in retail outlets, the quality or safety of the product could be reduced due to lack of adequate packaging or sufficient levels of chemical preservatives in the product.

Figure 9.2

products that arrive at the food processing plant as well as the processed food products that leave the plant. The personnel working in the quality control department have many responsibilities including the following:

- Having knowledge of all major areas of food processing
- Ensuring compliance with standards of identity for manufactured food products
- Ensuring compliance with government regulations for the use of additives
- Monitoring microbial content of ingredients and food products
- Evaluating sensory qualities of final products
- Ensuring that all final products meet required standards, regulations, and food laws

The food scientists that work in quality control departments are the key people in food processing plants that ensure the safety of the food products that appear in the supermarket.

Summary

- ☐ Food can become contaminated by adulteration, growth of microorganisms, or exposure to some form of environmental contaminant.
- ☐ The FDA has established regulations for acceptable levels of contaminants in food.
- ☐ The hazards of food-borne illness can be avoided by sanitary food handling and effective food preparation techniques.
- ☐ The four types of microorganisms that affect food are bacteria, viruses, yeasts, and molds.
- ☐ Bacteria are more commonly involved in cases of food-borne illness than are viruses, yeasts, and molds.
- ☐ The HACCP concept provides the food industry with a system of checks and balances that monitors the quality control procedures.
- ☐ The major function of the quality control department is to monitor all the raw food products that arrive at the food processing plant as well as the processed food products that leave the plant.

Vocabulary

bacteria
contamination
environmental contaminants
food-borne infection
food-borne intoxication
Hazardous Analysis Critical Control Point (HACCP)
microbial contaminants
microorganisms
molds
viruses
yeasts

Review

1. Why is it important for consumers to be informed about food safety?
2. How does food become contaminated?

3. List the two possible sources of environmental contamination.

4. How can the growth of harmful microorganisms be stopped?

5. Explain the various methods of destroying the organisms from bacteria, yeasts, viruses, and molds.

6. List preventive measures for each of the following food-borne illnesses: staph, botulism, perfringens poisoning, salmonellosis, and listeriosis.

7. Explain the three hazard categories named in the HACCP concept used by the food industry.

8. Give three examples of how food contamination might occur at any stage of food production, food processing, or food distribution.

9. What is the major function of the quality control department?

10. List the responsibilities of the food scientists who work in quality control departments of food processing plants.

Critical Thinking

Evaluate the food safety procedures used in your home economics laboratory or in your home. What changes/improvements need to be made? Justify your reasoning for any changes or improvements that would improve food safety.

10

Methods for Processing Foods

ESSENTIAL ELEMENT

☐ Assess methods for processing foods.(j2C)

OBJECTIVES

☐ Contrast the various methods used to preserve foods in commercial and home food processing.

☐ Differentiate between the preparation methods used in food processing both commercially and at home.

☐ Determine the role of packaging in food processing.

Food processing includes all the methods of preparing food so that it is readily available to be used by the consumer. Food processing includes the washing, trimming, and sorting of fresh produce and the highly efficient methods of food preservation used by the food industry today. It is food processing that enables cattle, wheat, and sugar cane to become steak, milk, flour, and sugar. Advancements in food processing in the United States have allowed consumers to have access to the broadest selection of food items in the world while using the lowest percentage of income than any other country in the world.

People have been preserving food for thousands of years. ***Preserving*** includes the methods of preparing food so that it can be safely stored for long periods of time. For centuries, people have been plagued with the problem of manipulating the food supply so they have food to eat during long winter months or during seasons of bad weather. Historically, one of the major challenges for early civilizations was to provide a year-round food supply for their citizens.

Food manufacturing and processing can be traced back to early Egypt and Rome where bakeries made bread that was ready to eat. Until that time, individuals had to grind their own wheat, make the flour, and then bake their own bread. Original methods of food preservation included drying; freezing food outdoors during the winter; placing food in cold storage cellars; and curing with salt, smoke, spices, sugar, or vinegar. Colonial women preserved milk by making it into cheese. The canning process was invented in 1810. Since that time, safe, modern food preservation methods have provided American consumers with a year-round supply of a large variety of foods.

Food preservation is necessary to prevent food spoilage. Food spoilage can result from the growth of microorganisms or from pests such as insects and rodents. ***Microorganisms*** are the bacteria, molds, and yeasts that grow in food when given the proper environment. These microorganisms not only cause changes in the flavor, smell, and appearance of foods but also can cause serious food-borne illness. The various methods of food preservation protect the food supply from food spoilage and allow for widespread storage and distribution of foods.

Food processing methods involve two areas. One includes the methods involved in the preservation of food. The second area involves methods of preparation that make the food suitable for use.

PRESERVATION METHODS

Modern technology has provided the food industry with a wide variety of food preservation methods from which to choose. This technology allows food manufacturers to select food preservation methods for individual foods that will allow for optimum nutrient retention, flavor, texture, and appearance. Consumers have come to expect only the highest quality food items from manufacturers. This broad list of food preservation methods includes the following:

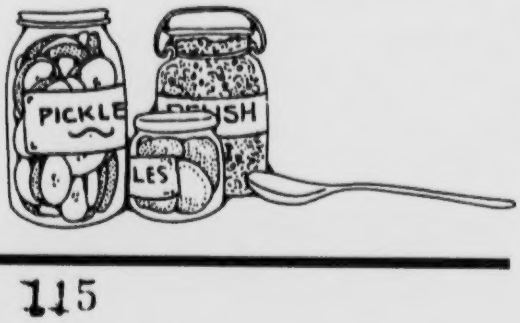
- additives/chemical preservation
- aseptic packaging
- canning
- cold storage
- curing
- drying/dehydration
- fermentation
- freezing
- irradiation
- modified atmosphere
- pasteurization

Additives/Chemical Preservation Methods

Chemical preservation of food involves the addition of chemical substances as a means of preventing spoilage and retaining organoleptic properties such as color, flavor, odor, and texture. ***Organoleptic properties*** are those properties that involve the senses. Chemical preservation is also used to help retain nutrients in preserved foods. However, the main function of chemical preservation methods is to prevent microbial spoilage. Microbial spoilage occurs when microorganisms are allowed to grow within food products. Chapter Five included a discussion of chemical additives used to preserve foods. Chemical preservatives are normally used as a part of another processing method such as heating. Some common additives or chemical preservation methods include acids, salts, sterilizing agents, and sugar and smoke.

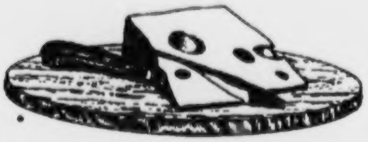
Acids. Acids are used as preservatives in foods to reduce the pH level of the food. The ***pH level*** is the degree of acidity or alkalinity of a substance. All microorganisms have the ability to grow at certain pH levels. Most bacteria grow at pH levels of 5.0 to 7.0. Yeast and molds can grow at significantly lower levels. Preservation with acids is usually combined with other methods such as heat pasteurization, refrigeration, or salting.

- Vinegar – Acetic acid is used in combination with sodium chloride (salt) in pickling. Growth of microorganisms is inhibited as long as these products are stored at low temperatures.



- Citric Acid – Citric acid, which is the acid found in limes and lemons, is most commonly used in tomato products. The addition of citric acid prohibits the growth of spore-forming bacteria.

- Sorbic Acid – Sorbic acid is most effective as an antimicrobial agent and is most useful in foods with low pH levels. It is found naturally in some fruits and berries, or it may be made in a laboratory. Sorbates are the sodium salts of sorbic acid and are also used as preservatives, especially in baked goods, cheese products, and dried fruit.



- Sodium Benzoates – Sodium benzoates are the sodium salts of benzoic acid. Benzoic acid occurs naturally in some plants such as anise seeds, cinnamon, cloves, and plums. Benzoates also inhibit growth of microorganisms and are used primarily in carbonated beverages, fruit juices, pickles, and sauerkraut.
- Propionic Acid – Propionic acid is made from bacterial fermentation and is found naturally in some dairy products. Propionic acid is used primarily as a preservative in bakery products. Propionic acid inhibits the growth of mold and bacteria in breads and cheeses.

Salts. Salt is one of the oldest known preservatives and is still very useful in prohibiting the growth of certain types of microorganisms. In some foods, salts are used in conjunction with water to form a brine. ***Brine*** is the name for the salt and water or salt and vinegar solution.

Sodium nitrite (or nitrite) is a preservative made either synthetically in the laboratory or as a result of the bacterial action in meat treated with sodium nitrate. This bacterial action converts nitrate into nitrite. Nitrite is used not only as an antimicrobial agent in cured meats but also to produce the color of cured meat products such as ham. Nitrite also develops and fixes the colors of cured meat products. Nitrite is known to prevent botulism and other food-poisoning bacteria.

Sterilizing Agent. Ethylene oxide is an antimicrobial agent used to sterilize spices.

Sugar and Smoke. Sugar and smoke are also effective preservatives. Sugar binds the water in food so that it cannot be used by microorganisms. Smoke contains guaiacol, which acts as an antioxidant. Antioxidants slow down the loss of nutrients and quality in food caused by oxidation. Antioxidants and oxidation are discussed in Chapter Four. However, smoking is not suitable for meat and fish that need to be preserved for long periods of time. Most of the smoking of foods today is for the purpose of adding flavor. The Food Additive Amendment of 1958 restricts the use of chemicals in food to those that are approved by the Food and Drug Administration. Chapter Five gives detailed information on the use of additives in the food supply.

Aseptic Packaging

Aseptic packaging is a method of preserving food by sterilizing the food first and then packaging it in sealed, sterile containers in a sterile atmosphere or chamber. This process enables the food to be stored indefinitely without refrigeration. The most commonly used materials for aseptic packaging include foil-lined cartons, plastic bags, and cups for products juice and puddings. Aseptic packaged foods have a better flavor than the same foods packaged in cans or glass containers. Foods that are packaged in glass or cans require lengthy heating times for complete sterilization. Aseptic packaging allows the food to be sterilized before packaging so the heating time is greatly reduced. Flavor changes occur after lengthy exposure to heat. Its use is becoming more prevalent because it is less expensive and more convenient than other methods of food preservation.

Canning

Canning is one of the most common types of food preservation used commercially and at home. Canning has been used as a method of food preservation since the early 1800s. Today, a wide variety of foods are canned because of their convenience and extended shelf life. Some families own pressure canners so that they can safely preserve the vegetables from their home gardens. ***Canning*** involves sealing food in airtight containers and then heating them at high temperatures to destroy any microorganisms and spores that may be present. Commercial canning involves several steps which include the following:

1. Raw food preparation – washing, trimming, cutting, slicing, peeling
2. Filling of containers – Machines fill the metal or glass containers with the raw food product. Manufacturers must carefully judge the amount of head space that is left when filling the containers. ***Head space*** is the amount of space for air that exists between the food and the top of the container. If there is too much head space, the shelf life will be reduced. If there is too little head space, the containers could bulge during the heating process.
3. Exhausting – In commercial canning, exhausting creates a vacuum in the container by removing air from the product and the head space. A vacuum is necessary to ensure a good seal and to maintain container integrity (quality).
4. Sealing – Sealing involves closing the containers with airtight lids.
5. Processing – In this step, filled containers are placed in large cookers called ***retorts***. Here they are heated at carefully calculated temperatures for specific lengths of time. The heat destroys the microorganisms that could cause food spoilage. *Clostridium botulinum* spores will not grow and produce toxins at a pH of 4.6 or less (acid). Foods above 4.6 must be pressure processed at high temperatures in order to kill the heat-resistant spores. The pH level is the degree of acidity or alkalinity of the food. An explanation of pH level is given in Chapter Four. Table 10.1 lists some pH levels of commonly eaten foods. Levels ranging from 0 to 7 indicate acidity, and levels of 7 to 14 indicate alkalinity. It is during this step that some of the nutrients are lost and changes occur in flavor, color, and texture.

pH levels of Common Foods

Food	pH Level
Lemons	2.2
Cranberry sauce	2.3
Vinegar	2.9
Plums	2.9
Apples	3.1
Apricots	3.3
Strawberries	3.4
Peaches	3.5
Blueberries	3.7
Pears	3.9
Tomatoes	4.0 to 4.6
Carrots	5.0
Pumpkin	5.0
Green Beans	5.3
Asparagus	5.6
Potatoes	6.1
Corn	6.3
Milk	6.5-6.7
Hominy	7.0

Table 10.1

6. Cooling – When the processing time is concluded, containers are cooled quickly in order to prevent overcooking. Products may be air-cooled (cooled by circulating cool air) or submerged into cold water.

Home canning involves some of the same steps. It is important for the consumer who does home canning to be well informed of the necessary precautions needed for safe food preservation. Extension agents are excellent sources of information and instruction in home canning procedures.

Home canning involves the use of some special equipment. A large kettle called a boiling-water bath canner is used for canning acid foods such as tomatoes. However, due to the many varieties of low-acid tomatoes, the Texas A&M Agricultural Extension Service recommends that citric acid (such as lemon juice) be added to the jars immediately before filling with the tomatoes. Nonacid foods, such as vegetables and meats, must be canned in a pressure cooker or pressure canner. These cookers have racks that hold several jars at a time. The two methods of home canning are the boiling-water bath method and the steam-pressure method.

In the ***boiling-water bath*** method, filled jars are placed on a rack in a large kettle. The kettle is filled so that the jars are completely covered by at least one inch of water. The processing time begins when the water starts to boil and continues for the recommended amount of time.

The ***steam-pressure method*** is used for low-acid foods because a higher temperature is required to kill the microorganisms in these foods. The pressure canner that is used in this method retains the steam inside the cooker so that the high temperatures can be reached and maintained for the length of the processing time. It is very important to follow the manufacturer's instructions to avoid injury and to ensure a safely canned food product.

Cold Storage

Cold storage is commonly referred to as refrigeration. ***Refrigeration*** is cold storage of foods at temperatures between 32°F and 40°F. The growth of the microorganisms that cause food to spoil is retarded at these temperatures. Cold storage also helps retain the flavor, color, textures, and nutrient value of the food by decreasing the enzyme activity. Cold storage (refrigeration) extends the shelf life of perishable foods such as milk and cheese.

Curing

Curing is one of the oldest methods of food preservation. In the curing process, ingredients such as salt, sodium nitrite or sodium nitrate, spices, and sugar are added to the foods. Sometimes smoke is used in curing or for the addition of flavor. Each of the ingredients has a different purpose. Salt removes part of the water from the food and slows down the growth of microorganisms. Sodium nitrite or sodium nitrate is used as a preservative and helps the food retain its color. Spices are added for flavor, and the sugar prevents the salt from hardening the food product. The chemicals in wood smoke act as a preservative because they retard the growth of microorganisms.

Drying/Dehydrating

Drying is another method of food preservation that can be traced back to ancient history. Drying or dehydrating preserves the food by removing the water or moisture that is needed by all microorganisms to grow and develop. A wide variety of dried foods are available to consumers. Different drying techniques are used for the different foods. These techniques include the following:

- Drum drying – The food is spread on a rotating drum and then scraped off when the drying cycle is completed.
- Pulse-combustion drying – This method is used for foods that cannot be dried by other methods. It uses sound waves and heat to dry the food.
- Spray drying – This is the method used for making dried milk powder. The liquid milk is sprayed into a heated chamber. When hot air is blown into the chamber, the liquid converts to a powdered form.
- Sun drying – This original method of drying involves spreading the food in thin layers and exposing it to the sun for a number of hours.
- Tray drying – Food is placed on trays and exposed to hot air circulation.
- Tunnel drying – The food is placed on conveyor belts in tunnels while exposed to circulating hot air.

Fermentation

Fermentation is a method of food preservation that uses the chemicals from acceptable microorganisms to bring about the desired changes in the food. These acceptable microorganisms used in fermentation include the following:

- Yeasts – Yeasts convert carbohydrates into alcohol or carbon dioxide. Yeast is used in the fermentation process to produce wine and distilled alcoholic beverages. Yeast is converted to carbon dioxide in bread making.
- Molds – Molds work with bacteria to produce strong-flavored cheeses.
- Bacteria – Bacteria work alone as cultures to produce other cheeses, yogurt, pickles, and salami.

Freeze-Drying

Freeze-drying is a method used in commercial food processing that produces a high-quality product that retains its original flavor, texture, and nutrient content better than foods dried by other methods. A process called ***sublimation*** is used to freeze-dry foods. In this process, ice turns into a vapor without becoming a liquid. The food is frozen and then placed on heated trays in a vacuum chamber. The trays are heated to a temperature just below melting, which allows the ice to vaporize. The resulting product is a dry solid with a soft, spongy texture. Freeze-dried foods do not become hard as other dried foods and are rehydrated very easily. Freeze-drying is a very expensive process, so its use is limited to a very few food products such as coffee, instant soup mixes, mushrooms, onions, and strawberries.

Irradiation

One of the food preservation principles developed in the early 1950s is irradiation. ***Irradiation*** is a method of preserving food by exposing the food to ionizing radiation. These low doses of radiation kill bacteria and microorganisms that cause food spoilage and food-borne illness. After harvesting, the food is exposed to the radiation for a short time. Irradiation does not cause the food to become radioactive.

Irradiation has been approved to treat spices, fresh produce, poultry, and pork in the United States. The purposes of irradiation are to destroy harmful bacteria and microorganisms, to preserve the quality of the food, and to extend the shelf life of perishable food products. Irradiation has been successfully used in other countries to control the sprouting of potatoes and thus prevent spoilage of entire crops. Irradiation does not seem to change the appearance or taste and does not cause a major loss of nutrients.

Researchers in the United States have been studying irradiation for more than thirty years.

Many other countries have approved the use of irradiation on different food products. Consumers have voiced concern over the use of irradiation in the food industry. Some concern arises from lack of factual information about irradiation and also from confusion between nuclear power radiation and food irradiation. Food irradiation technology is the same as that used in medical technology. The FDA continues to study the effects of irradiation on food.

Modified Atmosphere

Modified atmosphere, or controlled atmosphere, is a method of preserving foods by changing the chemical content of the air in the storage area. When the air in the storage area is changed by increasing the level of carbon dioxide and decreasing the oxygen, perishable food products such as fruits and vegetables can be stored for longer periods of time without overripening or spoilage occurring. Different foods require different balances of chemicals in the stored atmosphere. This technique has proven to be very successful with apples, pears, and other types of produce.

Modified or controlled atmosphere storage also is used for products such as bacon, breads, cheeses, cooked meats, and cream and jam-filled cakes and bakery products. This method is also used to increase shelf life of fresh meat, poultry, and fish. The techniques of modified atmosphere have been used in shipping perishable food products to extend the life and protect the quality of the transported products.

Pasteurization

Pasteurization was discovered by Louis Pasteur in 1895. Pasteur found that harmful bacteria in milk could be destroyed by heating it to a certain temperature and holding it at that temperature for a specified length of time. This process of sterilization was named pasteurization after its founder, Louis Pasteur. The process of pasteurization is intended to kill all the bacteria that would be harmful to humans. Pasteurization also helps to extend the storage life of milk and to prevent rancidity.

PREPARATION METHODS

Preparation methods include those in which the food is changed or altered in some way prior to being processed or packaged for home or commercial use. These methods include the following:
- enzyme technology
- physical modification
- separation
- thermal modification

Enzyme Technology

Enzymes that naturally occur in foods are used in food processing. One method involves converting the starch found in foods such as corn and potatoes into dextrose. Dextrose is the crystal form of glucose that is widely used in commercial food processing. When the starch is heated, the enzymes allow the starch to be broken down into small units. High fructose corn syrups are made from cornstarch using enzyme technology. Enzymes also are used to clarify fruit juices in food processing.

Physical Modification

Many foods undergo some form of physical modification during food processing. Grinding, chopping, cutting, and slicing are all forms of physical modification. ***Physical modification*** is changing the food from one form to another. Grinding large roasts into hamburger meat is physical modification. The processing of ice cream involves whipping liquid ingredients with air in freezing temperatures.

The dairy industry uses physical modification in the homogenization process. ***Homogenizing*** milk involves forcing liquid through a valve under high pressure. This process breaks up the fat globules into tiny particles so it is distributed throughout the milk and is not distinguishable by the consumer.

Separation

Separation as a means of food processing has been used for centuries. Ancient civilizations separated the fruits and nuts they gathered according to size, color, or ripeness. Today, separation procedures are much more sophisticated. Peas are immersed in salt brine and gravity separates the young, tender peas from the older, tougher ones. Fruits and vegetables are separated according to size and color for grading. The extraction of juice from fruits such as apples, cranberries, grapes, and oranges is a separation process. Leaching is used to separate the oils in corn, cottonseed, peanuts, soybeans, and sunflower seeds. Decaffeinated products result from the separation process. Caffeine in coffee and tea is separated from the coffee beans and the tea leaves.

Thermal Modification

Thermal modification involves the use of heat to modify the food into the desired product. Frozen fish sticks are examples of thermal modification. In this process, blocks of frozen fish are cut into strips, battered, and then deep fried for only a short time. The completion of the cooking takes place during home preparation. ***Extrusion*** is a process that forms food into desired shapes by using heat and special equipment called extruders. Breakfast cereals, some snack foods such as cheese curls, some dog foods, meat analogues, and pasta are all made by extrusion. Meat analogues or meat replacements are food products made from plant proteins that have been shaped and formed to resemble meat products.

THE ROLE OF PACKAGING IN FOOD PROCESSING

Food manufacturers spend valuable time and money researching the best methods for packaging food products. All of the efforts of safe, efficient food processing are wasted if poor packaging results in a poor quality, damaged product arriving at the supermarket. The purpose of food packaging is to prevent deterioration or damage. However, food packaging not only continues to serve that purpose but also provides the consumer with content information (ingredients) and nutrition and serving size information.

Packaging also is used as a marketing tool through advertising, product design, and convenience features. Packaging has permitted food items to be sold through self-service. The technology of food packaging is extremely complex. The food manufacturers must consider many factors when selecting the proper type of packaging for individual food items. Figure 10.1 lists the factors to be considered.

Choosing the Ideal Food Package: Factors to Consider

- Compatibility with the food
- Disposability
- Ability to be labeled appropriately
- Weight
- Does not contain or is not made of toxic materials
- Is appropriately opaque, translucent, or transparent
- Opens and closes as desired
- Can be used with high-speed filling machines
- Is protected from damage due to heat and cold
- Is protected from damage during shipping and storage
- Is protected from light
- Provides proper sanitation
- Can be sealed from gases and odors
- Is tamper-resistant

Figure 10.1

Four main materials are used in food packaging today. These include glass, metal, paper, and plastics. When choosing the type of packaging material to use, the food manufacturer must consider the food composition and whether the food will be packaged in a liquid or solid state. The food manufacturer also must consider how the food will be stored, the cost of the packaging materials, and how the package will appeal to the consumer.

Glass

Glass is one of the oldest packaging materials and is still widely used today. The major advantages of glass include the following:

- It cannot be penetrated by gases and odors.
- Glass has no effect on the chemical or physical properties of the food.
- It seals and reseals easily.
- It works well for high-speed mechanical filling.
- Glass is inexpensive to manufacture.
- It is transparent.
- Glass can be labeled easily with paper.
- Glass is recyclable.

Some disadvantages of glass include the following:

- Glass is breakable.
- It weighs heavy.
- It is not biodegradable.

Since the many advantages of glass far outweigh the disadvantages, consumers will continue to see foods packaged in glass for years to come.

Metal

Metal is used in food packaging mainly for canning. Metal is ideal for heat processing due to the following advantages:

- It is easily manufactured.
- Foods packaged in metal are protected from gases, light, and odors.
- Metal has heat transfer properties.
- Metal maintains an airtight seal.
- It protects food from damage during transportation and storage.

Some disadvantages of metal for food packaging include the following:

- Steel used in manufacturing cans is heavy.
- Steel cans are expensive to manufacture.

It is possible for the metal can to have a chemical reaction with the food contents. Therefore, the steel used to manufacture food cans is coated with either tin, enamel, plastic, or other coatings. Acidic foods cause corrosion of metal that has not been coated.

There are many sizes and types of metal food cans used today. Metal also may be combined with other materials such as paper or plastic for use in food packaging. Aluminum foil is commonly used in this manner. Metal also is used by the food industry for beverage containers and aerosol cans (such as those used for whipped cream).

Paper

Paper is probably the most widely used packaging material in the United States. Paper is a popular food packaging material because of its many advantages. These include the following:

- It is easy to manufacture.
- Paper is lightweight.
- It is inexpensive.
- Paper is printable.
- It is versatile.

Paper does have some disadvantages. It does not protect food from gases, grease, odors, and water. For this reason, paper is often combined with other packaging materials, such as plastic films or foil. The combinations of these materials into multilayered materials are called ***laminates***. Examples of laminates are milk cartons and some cookie packages.

Plastic

Plastic provides the food industry with a versatile and flexible packaging material. The chemical process that creates plastics is called ***polymerization.*** Plastics used in food packaging today include cellophane, mylar, nylon, and saran. Plastics have many advantages as food packaging materials. These include the following:

- They can be formed into various shapes and sizes.
- They are heat sealable.
- They are inexpensive.
- They are not easily punctured.
- Some types are printable.
- They are stretchable.

Plastics vary widely in their permeability to all types of gases. This proves to be a disadvantage for use with some foods. Testing and experiments with plastics continue as food packaging engineers work to expand the use of plastic in the food industry.

Concerns over environmental issues have caught the attention of the food industry. Manufacturers and fast-food chain executives have received criticism for using packaging materials that are not biodegradable or recyclable. The food industry is working through research and development to change some of these practices.

American consumers would have to make many lifestyle changes without the many advantages of food packaging technology. Many of the foods most commonly used today would not be available if not for the advancements made in food packaging. Consumers would have to visit the supermarket daily to buy perishable foods that are now conveniently packaged for extended shelf life. Besides having the safest, most abundant food supply in the world, Americans have the added advantage of reasonable cost and convenience.

Summary

- ☐ Canning is sealing food in airtight containers and then heating the containers at high temperatures to destroy microorganisms that might be present.
- ☐ It is important for the consumer who does home canning to be well informed of the necessary precautions needed for safe food preservation.
- ☐ Drying or dehydrating preserves food by removing the water or moisture from the food that is needed by all microorganisms in order to grow and develop.
- ☐ The purposes of irradiation are to destroy harmful bacteria and microorganisms, preserve the quality of the food, and extend the shelf life of perishable food products.
- ☐ Preparation methods include those in which the food is changed or altered in some way prior to being processed or packaged for home or commercial use.
- ☐ The food manufacturer must consider many factors before selecting the proper type of food packaging to use.

Vocabulary

aseptic packaging
boiling-water bath method
brine
canning
extrusion
fermentation
food processing
head space
homogenizing
irradiation
laminates
microorganisms
modified atmosphere
organoleptic properties
pasteurization
pH level
physical modification
polymerization
preserving
refrigeration
retorts
steam-pressure method
sublimation
thermal modification

Review

1. Summarize briefly the history of food preservation.
2. Why is food preservation necessary?
3. What is chemical preservation of food? What is its main purpose?
4. Explain how acids are used in food preservation. Distinguish between those used commercially and those used in the home.
5. What is nitrite?
6. Name three advantages of aseptic packaging.
7. Describe the steps in commercial canning.
8. Describe the two methods of home canning.
9. How does drying or dehydrating preserve food?
10. Summarize the different drying techniques used in commercial food processing.
11. What are the advantages and disadvantages of irradiation?
12. Explain the freeze-drying process.
13. What is enzyme technology?
14. Give examples of how separation is used in food processing.
15. What factors must the food manufacturer consider when selecting the proper type of food packaging for food products?

Critical Thinking

Assume you are a food packaging engineer assigned the task of developing a new food packaging material using aluminum foil, paper, and plastic. If this is a multilayered material, which material (foil, paper, plastic) would be nearest the food? Which would be next? Which would be on the outside? Why? Give examples of food that would be suitable to be packaged in your new material. Give reasons why this would be successful.

11

The Impact of Food Processing

ESSENTIAL ELEMENTS

- ☐ Analyze the impact of processing on product quality, nutrition, and taste.(j2D)
- ☐ Discuss chemical reactions that occur during food processing.(j2E)

OBJECTIVES

- ☐ Summarize the basic principles and effects of food processing methods on food products.
- ☐ Analyze the development of food products for travel in space.
- ☐ Explain various chemical reactions that occur in foods during processing procedures.

Food processing alters or changes foods to create products that are needed and desired. Food processing provides consumers with foods that add nutritional value, variety, and flavors to their diets. Any time food is altered from its raw form into a different form, changes can occur in the quality of the product. In many instances, the quality of the food is improved by processing, whether through changes in appearance or in taste. However, food processing can change the nutritive value of food and lower the quality of the food if proper procedures are not followed.

EFFECTS OF FOOD PROCESSING ON FOOD QUALITY

Procedures used in home preparation of foods can cause as much or greater losses of quality and nutritional value than in commercial food processing. Commercial food processing plants have highly specialized equipment that regulate the time and temperature to which food is exposed. The commercial food processor carefully controls the factors that affect the quality and nutritional value of the food. Family members who prepare meals do not have such specialized equipment in the home, and they may not be nearly as careful in food preparation methods.

In Chapter Four, nutrient retention and the recommendation for eating a wide variety of fresh, as well as processed foods, was discussed. A person who eats a variety of nutritious foods has a diet that meets the minimum daily requirements for most nutrients. Food composition tables show average differences between fresh and processed forms of food. Food labeling also shows nutrient content. To fully analyze the changes in quality, nutritive value, or taste that occur in food processing, a person needs to do experimental comparisons. Table 11.1 shows a comparison of foods in various forms according to nutrient value.

It is important to remember that while food processing may affect the retention of some nutrients, it also improves the digestibility or availability of other nutrients. For example, pasteurization destroys the trace amount of vitamin C found in milk. However, pasteurization of milk is necessary to destroy harmful bacteria that would make it unsafe. Also, Americans do not depend on milk to supply vitamin C. The cooking of meat causes some of the thiamin to be lost, but it improves the digestibility of the protein.

Changes in Food During Processing

The changes that occur in food products during processing or preparation generally serve three purposes. These purposes include the following:

1. To preserve the food
2. To improve the quality of the food product
3. To provide consumers with food products that taste better and are more convenient than in their original form

The various methods of food processing and food preservation have different effects on food. Some methods may sacrifice some quality in order to destroy harmful microorganisms. Other methods may be able to preserve quality and nutrition, but the process may be more

Selected Nutrient Values in Various Food Forms

	Peas		Orange Juice		Salmon		Milk		
Nutrient	Raw	Canned	Fresh	From Frozen Concentrate	Fresh, Broiled	Canned	Fresh (Pasteurized 3.5% fat)	Fermented (Buttermilk 0.1% fat)	Dietary Requirements for Adults (mg/day)
					mg/100 g				
Thiamin	0.3	0.1	0.1	0.1	0.2	—	—	—	1.2
Riboflavin	0.1	—	—	—	0.2	0.2	0.2	0.2	1.5
Niacin	2.9	0.8	0.4	0.3	9.9	7.4	0.1	0.1	18.0
Vitamin C	27.0	8.0	49.6	47.3	—	—	0.9	1.0	60.0
Calcium	26.2	26.2	10.8	10.0	—	—	118.0	122.0	1200
Iron	1.9	1.9	0.2	0.1	1.2	1.0	—	—	15
Phosphorus	116.8	77.0	16.8	16.8	417.3	288.2	90.8	95.7	1200
Potassium	318.4	96.6	198.4	198.4	446.4	339.1	143.4	141.1	2000

Source: Adapted from "Nutritive Value of American Foods," by C.F. Adams, Agriculture Handbook No. 456, United States Department of Agriculture, Washington, D.C.

Table 11.1

Basic Principles and Effects of Food Processing Methods

Process	Principle of Preservation	Effects on Food
Chemical (Additives)	The growth of microorganisms is inhibited.	Quality, taste, texture, and color are retained. The function of ingredients is improved.
Curing (Pickling, Salting, Sugaring)	The addition of acids lowers pH levels, which inhibits microbial growth. Salt and sugar inhibit microbial growth by decreasing the availability of water.	Shelf life is extended. Texture and color may be affected.
Drying	The water that microorganisms need for growth is removed.	Flavor and appearance are affected. Some nutrients are lost. Shelf life is extended.
Fermentation	The acidity of the culture lowers the pH level, therefore reducing growth of microorganisms.	Flavor and appearance may be affected. Shelf life is extended.
Freezing	Low temperatures convert water to ice, which makes water unavailable to microorganisms for growth. It reduces enzymatic changes.	Texture may be affected, but color, flavor, and nutrients are retained.
Heat Sterilization (Canning)	Harmful microorganisms are destroyed. Enzymatic changes are reduced.	Some loss of heat-sensitive nutrients and water-soluble vitamins may occur. Flavor, texture, and color may change slightly. Lengthy shelf life stability is provided.
Irradiation	Beta or gamma rays are used to destroy harmful microorganisms.	Chemical reactions may affect flavor, color, or texture. Extended shelf life is provided.
Other Heat Sterilization Methods (Pasteurization, Smoking)	Harmful microorganisms are destroyed.	Heat-sensitive nutrients are lost. Shelf life is extended.
Refrigeration	Growth of microorganisms is slowed down or stopped by the low temperatures.	Flavor, color, and texture is retained, but the shelf life is very short. After periods of time, microbial growth can occur.

Table 11.2

expensive. The added cost is passed on to the consumer. Table 11.2 lists some common methods of food processing and the effects on food products.

FOOD IN SPACE

The scientific advancements that led to the ability to send men and women into space presented a new challenge to the food industry. If human beings could live in space, then provisions for the consumption of food became necessary. When designing food that could be consumed in space, food scientists had to consider the extremely different conditions that existed for astronauts. Factors that affected the development of food products for space travel included the following:

- zero gravity
- vacuum chamber of the space cabin
- complications induced by the complexity of the space suit
- storage
- shelf life
- packaging
- palatability
- convenience
- aesthetic value
- nutritional value
- disposal of food waste

Some of the first foods sent to space were freeze-dried. Other foods were compressed foods and fruit bars. The freeze-dried process is discussed in detail in Chapter Ten. The advantages of freeze-dried foods for space travel are the following:

- Flavor and nutrient value are retained.
- Refrigeration and heating are not needed.
- Foods are lightweight (due to the water being removed).
- Packaging is easy.
- Shelf life is unlimited.

Freeze-dried foods have a spongy texture that could affect desirability after a period of time. The freeze-drying process is also very expensive, and the variety of freeze-dried foods is limited. The texture of some fruits and vegetables is significantly affected by the freeze-drying process.

The United States space exploration program has led to the development of a new class of food called ***intermediate moisture foods (IMF)***. Intermediate moisture foods are produced by adding humectants like glycerol, salts, sugars, and other additives that restrict the water activity and thus retard spoilage. ***Humectants*** are chemical compounds that help foods retain moisture but restrict the water activity in the food. ***Water activity*** is a measurement of free water in a food system. Microorganisms must to have moisture to survive. If water is busy using salt, sugar, or other humectants, then bacteria cannot grow. The IMFs were developed using the principles from an old preservation technique used by the Native Americans. They mixed berries, cereals, meats, and other ingredients to make a product they called ***pemmican***. This mixture was partially dried to reduce spoilage, but the final product still retained enough moisture to make it chewable. IMFs produced today include breakfast bars, pet foods, and foods used for space travel.

CHEMICAL REACTIONS DURING FOOD PROCESSING

All foods are made of chemicals. Some chemicals occur naturally in foods from plants and animals. Other chemicals have been duplicated in laboratories and are known as ***synthetic*** chemicals. When food is processed, regardless of the method used, chemical reactions take place. These are desired chemical reactions because they bring about the desired change in the food product that improves the quality of the product or retards spoilage. These chemical reactions perform the following functions:

- destroy or prevent the growth of harmful or destructive microbes
- eliminate or control toxins
- maintain nutritional quality
- maintain desirable odors and textures
- increase shelf life of foods

Table 11.3 lists the factors involved in these chemical reactions.

The food processing industry of today incorporates aspects from seven different fields of science. These include the following:

- agricultural science
- chemistry
- economics
- engineering
- marketing
- microbiology
- nutrition

It is the combined knowledge and information gathered from all of these areas that have brought the food processing industry to such a sophisticated level. Future plans for the food industry in the next century show many new and exciting products yet to come.

Factors that Influence Chemical Reactions in Food

Factor	Chemical Reaction
Acidity	The presence of acid in food lowers the pH level. The acid inhibits microbial growth.
Nutrients	In some foods, nutrients may be bound to other chemical compounds. This makes them unavailable for use by the body.
Oxygen	Oxygen is the principal factor needed for the growth of most living organisms. The absence of oxygen in some preservation methods inhibits the growth of microorganisms.
Temperature	Most microorganisms experience optimum growth at temperatures between 60°F and 120°F. Some microorganisms can survive in much colder temperatures of 32°F to 40°F. That is why extreme heat and freezing temperatures are used in food preservation.
Water	Water is one of the most important nutrients needed by microorganisms for growth. Water that is not bound by any other agent, such as salt, is "free" to be used by the microorganisms. When salt or sugar is added to food, the water is bound to the salt or sugar and is not available for use by the microorganisms. The same action occurs in freezing. The freezing temperature converts the water to ice, which cannot be used for microbial growth.

Table 11.3

Summary

- Procedures used in home preparation of food can cause as much or greater losses of quality and nutritional value than procedures used in commercial food processing.
- The commercial food processor carefully controls the factors that affect the quality and nutritional value of the food.
- While food processing may affect the retention of some nutrients, it also improves the digestibility or availability of others.
- The changes that occur in food products during processing or preparation generally serve three purposes. These include the following:
  - to preserve the food
  - to improve the quality of the food product
  - to provide consumers with food products that are more palatable and more convenient than in their original form
- The U.S. space exploration program has led to the development of a new class of food called intermediate moisture foods.
- When food is processed, regardless of the method used, chemical reactions take place.

Vocabulary

humectants
intermediate moisture foods (IMF)
pemmican
synthetic
water activity

Review

1. Why is food likely to suffer more loss of quality and nutrients in home food preparation than in commercial food processing?
2. List the three purposes of food processing.
3. Which methods of food preservation have the most positive effects on the food product?

4. Which methods of food preservation have the most detrimental effects on the food product?
5. List the factors involved in development of food products for space travel.
6. What are the advantages of freeze-dried foods in space?
7. Why are intermediate moisture foods satisfactory products for space travel?
8. What are the functions performed by the chemical reactions that occur in food during food processing and food preservation?
9. List the factors that influence the chemical reactions. Give a brief explanation of each.
10. Briefly explain how each of the seven different fields of science are involved in the food processing industry.

Critical Thinking

Assume you are a food technologist associated with NASA (National Aeronautics and Space Administration). You have a team of three product development specialists working with you to develop new food products for a space flight that will orbit the earth for three months. Today, each of your team members presents an idea for a new food for space travel. Describe these new products and evaluate them according to information from this chapter and other resources. Consider all the factors listed in the chapter concerning development of food for space. Share the ideas for the new products and your critical evaluation of each one with your classmates.

Consider the effects of the various food processing methods and principles of food preservation on microorganisms that cause food spoilage. These food products have been left in the refrigerator for five days:

- an opened can of cream of potato soup
- a package of frozen spinach that has thawed
- a quart of reconstituted nonfat dry milk

Evaluate each of these foods to determine if microbial spoilage will have occurred. What principles of food preservation are involved? Explain why each of the foods may or may not be spoiled after five days.

12

Quality of Food Products

ESSENTIAL ELEMENT

☐ Evaluate the quality of food products for compliance with established standards.(j3A)

OBJECTIVES

☐ Identify the various food laws and agencies that regulate food quality and wholesomeness in the United States.

☐ Explain the food standards of content and quality through standards of identity, standards of quality, and fill-of-container.

☐ Compare laboratory evaluation methods for food products.

With the growing number of products available on the market today, average consumers do not have the time or the ability to inspect and evaluate the foods they purchase. With the variety of package shapes and sizes, it is often difficult for the manufacturer to provide enough useful information for consumers so that they can make wise selections. Several laws have been passed to ensure consumers that they can buy foods that meet specified standards of wholesomeness. The present laws cannot guarantee consumers that all inferior foods and misleading packaging have been eliminated, but laws provide the best means to regulate the food industry.

Food safety and the need for regulations became a major concern in the 1800s. The first law regarding food standards of content and quality was the ***British Food and Drugs Act*** passed in 1860. Subsequent regulations were passed in almost every country.

UNITED STATES FOOD LAWS AND REGULATING AGENCIES

Commerce refers to the buying and selling of goods. All meat and poultry sold in ***interstate commerce*** (between states) or ***foreign commerce*** (with other countries) must be inspected by the federal government for wholesomeness and truthful labeling. There are many local, state, and federal agencies that regulate the safety of the food produced and eaten in the United States. Similar organizations regulate food in other countries. Meat and poultry bought and sold ***intrastate*** (within a state) must be inspected by state inspectors following guidelines that are at least equal to federal regulations. If a state is unable to inspect and regulate its own program, the United States Department of Agriculture (USDA) Food Safety and Inspection Service must assume the responsibility. In addition to inspecting, USDA officials examine shipments of meat from other countries to identify uninspected meat and poultry, imitation or false inspection stamps used to deceive or defraud the quality of the product, inaccurate labels, and unwholesome products.

Food Laws

The numerous food regulating agencies in the United States receive their authority or power and funding from the numerous food laws that have been passed. Many of the laws passed have been replaced or revised at some point in time. Some regulations may be the responsibility of one agency or may require the combined efforts of two or more agencies.

The ***Pure Food and Drug Act*** (also known as the Wiley Act) of 1906 was intended to prevent the manufacture, sale, or transportation of foods, drugs, and liquors that are adulterated, falsely labeled, poisonous or deadly, or harmful.

This act defined ***adulteration*** as those foods containing "any added poisons or other added deleterious (harmful to one's health) ingredient which may render such article injurious to health."

The ***Meat Inspection Act*** of 1907 is enforced by the Food Safety and Quality Service division of the USDA. Prior to 1977, it was regulated by the Meat Inspection Branch of the Bureau of Animal Industry. This act requires that all meat and/or meat food products involved in interstate commerce or imported from abroad be packaged under the direction of and regulations of USDA guidelines.

The ***Weight and Measure Amendment to the Wiley Act*** of 1913 clarified the rules regarding the manufacturer's obligations to state the quantity of the contents in packaged food products.

The ***Kenyon Amendment to the Wiley Act*** of 1919 required the weight and measurement be labeled on packaged meats.

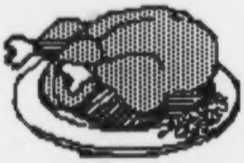
The ***McNary-Napes Amendment to the Wiley Act*** of 1930 authorized the USDA to establish minimum standards for quality, condition, and amounts of food products in cans. The minimum standards are required of all canned products except meat and milk.

The ***Seafood Inspection Amendment to the Wiley Act*** of 1935 authorized the USDA to inspect seafood products that might enter into interstate commerce. The inspections were not mandatory but were to be provided to those food processing plants desiring the inspection service.

The ***Federal Food, Drug, and Cosmetic Act*** of 1938 authorized the Food and Drug Administration (FDA) to regulate food, drug, and cosmetic production to ensure that products were safe, pure, and wholesome. The FDA was also authorized to ensure that products were made or processed under sanitary conditions and were honestly packaged and labeled. The FDA was to establish food standard regulations regarding product packaging. Minimum standards were set for tenderness, color, and defects. Standards for enrichment (addition of nutrients to a product) were set with regulations implemented for products labeled as "enriched" or "fortified" (nutrients not naturally present are added). The act also provided standards for certain additives in products that are added unintentionally and are not necessarily desirable in foods. These unintentional additives may be added to products because they are either necessary in production or unavoidable.

The ***Agricultural Marketing Act*** of 1946 is also administered by the USDA. It provides inspection and regulation standards for ***grading*** (rating according to quality) raw and processed foods such as chickens and eggs. Funding for research on processed foods was also provided by this act as well as information and assistance for marketing farm products.

The ***Miller Pesticide Amendment*** of 1954 established acceptable levels for pesticides and chemical residues used on agricultural products. Pesticides are chemicals used to kill insects on plants. Occasionally, the chemical in the pesticide can leave a harmful residue on the plants. Any pesticide used must be approved by the USDA as well as the FDA.



The ***Poultry Products Inspection Act*** of 1956 required inspection of all fresh, frozen, ready-to-eat, and canned poultry products bought and sold between states. Labeling requirements were established for these products. The USDA was given the authority to enforce these requirements. This act was amended or altered in 1968 and its name was changed to the ***Wholesome Poultry Products Act***. It requires inspection of poultry and poultry products regardless of whether they are involved in interstate or intrastate commerce.

The act also provides individual states with financial assistance or federal employees to work with state inspection employees to improve their poultry inspection programs. Inspectors enforce regulations on cleanliness and efficient equipment. Poultry and poultry products are tested to see if they are safe to eat.

The ***Food Additives Amendment*** of 1958 made it necessary for a manufacturer to demonstrate the safety of a new additive before its use could be approved by the FDA. This amendment also included the ***Delaney Clause*** which stated that no additive would be considered safe if it were found to produce cancer when ingested by man or animals or if it were found to cause cancer in man or animals.

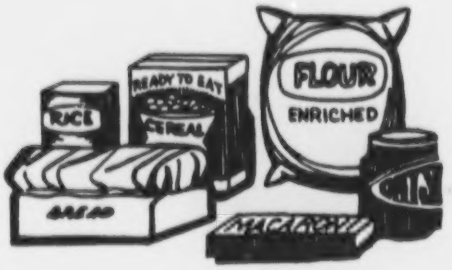
The FDA's ***Pasteurized Milk Ordinance*** was first established in 1924 in response to studies that identified the role of milk in the spread of disease. In an effort to assist states and cities in establishing effective programs for preventing the transmission of disease through milk, the Public Health Service established a plan known as the Standard Milk Ordinance.

The Standard Milk Ordinance has been revised several times and is now known as the Pasteurized Milk Ordinance. The ordinance establishes standards for high sanitary quality of milk and milk products. Standards exist for the health of animals and personnel, water supply, sewage disposal systems, pasteurization equipment, and milk production methods. States, counties, and cities are urged to legally adopt this ordinance to encourage greater uniformity of milk sanitation practices in the United States.

The ***Fair Packaging and Labeling Act*** of 1967 required that all labels on packaged foods contain four important facts. These must be clearly printed on the label.

1. identity of the food
2. the name and address of the manufacturer, packer, and distributor
3. net contents (actual weight without the package) of the product
4. ingredients must be listed on a single panel

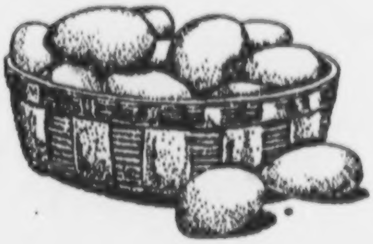
with the common names of the ingredients appearing in decreasing order of percentages



The FDA is in the process of amending the food labeling regulations. The new law will require nutrition labeling on most foods. The action was taken due to increased scientific knowledge about the relationship between health and certain food components such as cholesterol, fats, fiber, and sodium. It was also influenced by the growing public interest in the nutritional status of food products. The new labeling will be required on almost all packaged foods as well as fresh fruits, vegetables, and fish. These new labeling regulations may also be required of restaurants. If regulations are passed, nutritional information on foods served will be required to be easily accessible to customers. Restaurants and fast-food establishments may be required to place nutrition information on menus or have the information accompany the food in some written form.

The *Egg Products Inspection Act* of 1970 is administered by the USDA. The act is intended to assure that the eggs and egg products that reach the consumer are wholesome and free of harmful substances. The act provides that the Agricultural Marketing Service be responsible for the continuous mandatory (required) inspection in plants that process liquid, dried, or frozen egg products.

Eggs are one of many products that are imported into the United States. To import is to bring items into a country from another country to be sold. Eggs are also exported. Export means to carry or send items to other countries to be sold and consumed there. Eggs and egg products may be imported from foreign countries only if the country's inspection system is equal to that of the United States. Currently, the only countries eligible to export eggs and egg products to the United States are Canada and the Netherlands.



Agencies That Oversee Food Quality and Wholesomeness

Many agencies have been established to oversee food quality and wholesomeness in the United States. Many of these agencies are regulatory or managing agencies. The USDA is one of many agencies that regulates food and beverages in the United States. Other agencies serve as sources of information and guidance to the industry and the public. Some of these agencies are listed as follows:

- The ***Bureau of Alcohol, Tobacco, and Firearms*** is responsible for enforcing the laws that cover all aspects of the alcoholic beverage industry. Wine beverages that contain less than 7 percent alcohol are the responsibility of the FDA. The bureau and the FDA share responsibility in cases where alcoholic beverages have been adulterated or made unsafe with food or color additives, contaminants, or pesticides.

- The ***Centers for Disease Control*** is a branch of the Department of Health and Human Services that helps inform the public of diseases and food-related illnesses. However, it is not a regulatory agency. The center becomes involved in situations or isolated cases where food-borne illnesses or diseases cause a threat to individuals and the public as a whole. If a person eats a particular brand of food and the person gets food poisoning, the center would not only investigate the situation but would also help local health authorities pass the information along to the public. The center would also be involved in removing the product from the grocer's shelves or from the factory or plant so that the contaminated product could be destroyed and not cause further damage.

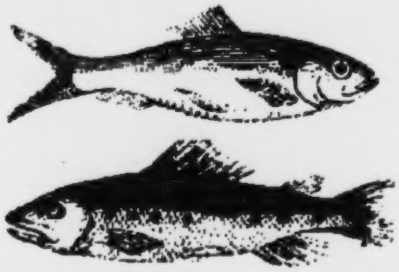
- The ***Environmental Protection Agency (EPA)*** regulates pesticides and pesticide use. Before any pesticide can be sold or used in the United States, it must be approved by the EPA. The EPA also establishes acceptable levels of pesticides in foods. Another responsibility of the EPA is establishing water quality standards.

- The ***Federal Trade Commission (FTC)*** is an agency that protects consumers at the state and local levels. The FTC has the authority to regulate the following:
  - product pricing to increase fairness to consumers and competitive products
  - deceptive advertising such as exaggerated claims for a product
  - deceptive packaging
  - deceptive selling

BEANS
Peanut Butter

- The ***Food and Drug Administration (FDA)*** is a part of the Department of Health and Human Services' Public Health Service and is responsible for enforcing the Food, Drug, and Cosmetic Act of 1938. The FDA is responsible for the safety and quality of all foods involved in interstate commerce with the exception of meat, poultry, and eggs. Meat, poultry, and eggs are inspected by the USDA. The FDA has the shared responsibility with other agencies to enforce the safety and sanitation regulations of certain products. Packaging, labeling, and egg product inspections are regulated.

  The FDA monitors recalls of unsafe or contaminated foods. ***Recalls*** refer to the process of ordering a return of a specific product so that the manufacturer can repair a particular defect or replace the product if it is unsafe. Products found to be in violation of federal regulations can be seized and removed from the grocer's shelves or the factory by the federal courts. The individuals or firms responsible for the violations may be arrested. The FDA is also responsible for nutrition labeling.



- The ***National Marine Fishery Service*** is a division of the United States Department of Commerce. Its primary responsibility is to regulate seafood quality and various aspects of the seafood industry. There is no mandatory inspection of seafood or grading standards, but a voluntary inspection program is available for those requesting it.

- Through inspecting and grading, the ***United States Department of Agriculture (USDA)*** enforces standards for quality of meats, poultry, eggs, and livestock that are imported from other countries and inspects food processing plants. The USDA makes grading (quality) inspections for grain, vegetables, meat, poultry, eggs, milk, and other dairy products that are produced in the United States. The department also is involved in nutrition research and in educating the public about food and nutrition.

- The ***United States Public Health Service*** has no power to enforce laws, but it provides state and local governments with recommendations for establishing food ordinances. Its principle function is to help other agencies protect public health.

State and local governments have the responsibility of inspecting retail food establishments, restaurants, dairies, and grain mills. The FDA provides guidelines for state and local governments regarding restaurants and dairy products. State and local government laws may be more strict than federal laws but are never more lenient. State laws are responsible for governing food and food products produced and sold within the state.

FOOD STANDARDS OF CONTENT AND QUALITY

The FDA has the authority to determine food standards of identity, quality, and fill-of-container and to administer requirements of the Federal Food, Drug, and Cosmetic Act. There have been amendments in the law (1954 and 1958) since it was passed in 1938, but for the most part, the act has remained in its original form.

Standards of Identity

Definitions and standards of food products, called ***standards of identity***, have been established to define the composition of the most commonly used food products such as butter and mayonnaise. However, because there are so many new products on the market combined with the existing products, standards have not been set for many products. These food standards do not apply to fresh or dried fruits and vegetables. Examples of standardized foods or foods that have standards of identity include most breads, ice creams, canned fruits and vegetables, and federally inspected meat and poultry products. A particular food product must meet the defined standard of identity before it can be called a certain product. An example of a standard of identity for mayonnaise is in figure 12.1.

Standard of Identity
for
Mayonnaise

Mayonnaise or mayonnaise dressing is the semisolid food prepared from:

- Vegetable oil(s)
- One or both of the following ingredients
  - – any vinegar or any vinegar diluted with water
  - – lemon juice and/or lime juice in any appropriate form, which may be diluted with water
- One or more of the following egg yolk containing ingredients: liquid egg yolk, frozen egg yolks, dried egg yolks, liquid whole eggs, frozen whole eggs, or dried whole eggs
- One or more of the following optional ingredients:
  1) salt
  2) sweeteners
  3) spice or natural flavoring
  4) monosodium glutamate
  5) preservative color and/ or flavor
  6) citric acid/or malic acid
  7) crystallization inhibitors

- All ingredients shall be safe and suitable.
- Mayonnaise contains not less than 65 percent vegetable oil.
- Mayonnaise may be mixed and packed in an atmosphere in which air is replaced in whole or in part by carbon dioxide or nitrogen.
- The name of the food is mayonnaise or mayonnaise dressing. Each of the ingredients used in the food shall be declared on the label as required.

Adapted from the Code of Federal Regulations, Title 21; Chapter 1-FDA: Subchapter B, Part 169 as referenced in *The Almanac of the Canning, Freezing, Preserving Industries*, Seventy-third edition, Edward E. Judge & Sons, Inc. 1988, pages 322-323.

Figure 12.1

Standards of identity were enacted to provide consumers with protection from deceptions, sanitary controls, health safeguards, and required label statements. The establishment of health safeguards made it illegal to sell or attempt to sell food that is unsafe or a health hazard. Food containers also must be safe and free from any poisonous substance that might cause the food to become unsafe. Any color added to a product is under the same regulations. Any color additive must be approved by the FDA before it can be considered safe for use in any food product. Sanitary safeguards prohibit the sale of any food that is unclean, decomposed, or packed or held under unsanitary conditions because the food may have become contaminated, making it unsafe for human consumption.

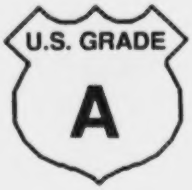
The clause regarding food deception states that a food cannot be sold under any name other than its own. Food containers must provide accurate information about the amount of the contents in the container.

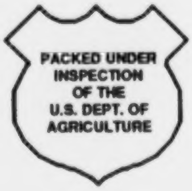
Food labels cannot contain any false or misleading information about the product. The information must be printed in English in a noticeable place on the package. The labels also must state the name and address of the product manufacturer and/or the packer or distributor, and the accurate weight of the contents.

Standards of Quality

Standards of quality are the minimum requirements for the quality of food products. Characteristics with standards include color, tenderness, and freedom from defects (of canned foods). Mandatory standards of quality for certain food products are determined and enforced by the FDA. These standards are different from the voluntary standards for grading meat the USDA uses. USDA grades are used by both consumers and wholesalers to select cuts of meats. The standards of quality established by the FDA are used for wholesale trading purposes because the quality of the product affects the price of the product. If foods do not meet the standards of quality established by the FDA, the product must bear a label stating its quality. For example, a product might be labeled as *Below Standard of Quality*, *Excessively Broken*, or *Excessive Peel*. These labels are used primarily by wholesalers and are seldom seen by the consumer.

The United States Department of Commerce is responsible for the inspection and grading of fish and fish products. This responsibility may be given to another agency soon. The agency responsible may be the FDA. Fish and fish product inspection and grading are currently voluntary and available to the industry upon request for a fee. Fish products that meet federal regulations may be marked or stamped with the U.S. inspection seals along with the grade identification mark of the product. Quality grades include Grade A, B, and C with Grade A being the best quality. Grade C is of good quality and of good nutritional value, but it is not as attractive in appearance as Grades B or A.




PACKED UNDER INSPECTION OF THE U.S. DEPT. OF AGRICULTURE

The USDA has two agencies that perform grading inspections. The ***Agricultural Marketing Service*** and the ***Federal Grain Inspection Service*** provide voluntary grading inspections and in some situations, mandatory inspections. The Federal Grain Inspection Service provides the mandatory grading services for most food and farm products. The exporters, processors, or packers who request the service are charged a fee. The number of grades for each food product varies depending on the product's variability. There are three grades for turkey while there are eight grades for beef. The grades are continually reviewed and appraised by experts to assure their consistency with current market practices. The USDA grading standards for meat, poultry, milk products, and eggs follow.

Meat. The grading of beef does not indicate the nutritional value of the meat but represents two factors: yield and quality. ***Yield*** refers to the amount of edible lean meat available. ***Quality*** refers to probable tenderness and palatability (acceptability to the taste) of the cut of meat after the meat is cooked. An inspector grades the meat in the body or carcass form. There are basically eight grades of meat: Prime, Choice, Select, Standard, Commercial, Utility, Cutter, and Canner.

Prime grades are typically those used in restaurants and sold in meat markets. ***Choice grade*** and ***select grade*** are typically found in grocery stores. The meat from these three grades usually comes from well-fed animals that are less than two years old. The other grades are typical used in ground beef, canned meats, and sausages. Fewer grades are used for smaller animals such as the following:

- veal (young calf)
- lamb (young sheep)
- mutton (grown sheep)

Pork is graded in a similar manner to beef. Beef is graded by name (prime, choice, good) while pork is graded by number—U.S. No. 1, 2, 3, 4, or Utility—with the U.S. No. 1 being the top grade. The Utility grade is used in processed pork products such as canned pork mixtures and sandwich spreads.

Poultry. Poultry inspection is mandatory; however, grading is optional. Most reputable processors have their poultry graded, and it is often done at the same time an inspection is done. The types of poultry that are graded include the following:

- chicken (common farm bird that is raised for eggs or its flesh)
- duck (small waterfowl with a short neck and legs, webbed feet, and a flat bill)
- goose (long-necked, webbed footed water fowl similar to a duck but larger)
- guinea fowl (member of a family of African birds characterized by a featherless head, round body, and dark feathers with white spots)
- squab (newly hatched pigeon)
- turkey (large, North American bird with a bald head and spreading tail bred for its flesh)

Poultry grades are A, B, and C. Grade A is the best quality. The characteristics used for grading include the following:

- freedom from pinfeathers – The more pinfeathers (undeveloped feathers that are coarse and hairlike), the lower the grade.
- amount of fat on the bird – Some fat is needed but too much lowers the grade.
- shape of the bird – A well-proportioned, plump shape is best.
- number of disjointed or broken bones – Disjointed or broken bones lower the grade.
- number of cuts, tears, and other skin and flesh blemishes – The more blemishes there are, the lower the grade.

Milk. Fresh milk is graded according to its bacterial count or the amount of bacteria found in the milk. All milk has some bacteria. Grade A is the highest grade. Grade A has the lowest bacterial count of the three grades. Grades B and C are also safe and wholesome grades of milk. In most areas, only one grade of milk is sold based upon recommendations by the Public Health Service. The grade sold in one community may be different than the grade sold in another community.

The types of milk designated by government standards of identity are included in figure 12.2. Government standards for other dairy products also exist for various types of cream, butter, cheese, yogurt, and frozen desserts.

Eggs. Grades established for eggs have been divided into four categories. The grades are AA, A, B, and C. Grade AA is the best quality and due to its thick egg white the most satisfactory for poaching (cooked out of the shell in water or other liquid or in a small utensil over the water or liquid near the boiling point). It is also best for frying and cooking in the shell. Grade A eggs do not poach as well but are satisfactory for cooking and frying. The appearance of grade B eggs may be somewhat irregular both inside and outside the shell, but the nutritive value is the same as the AA or A. Grade C eggs are usually not available for consumers to purchase.

Types of Milk

Whole milk is homogenized and fortified with vitamin D. It must contain a minimum of 3.25 percent milkfat. The milk must also meet minimum milkfat requirement set by the state or community where it is sold.

Low-fat milk has between 0.5 and 2 percent milkfat and is fortified with vitamin A. Vitamin D fortification is optional.

Skim milk must have less than 0.5 percent milkfat and must be fortified with vitamin A. Vitamin D fortification is optional.

Flavored milks are made by adding fruit, fruit juice, or other natural or artificial flavorings such as strawberry, chocolate syrup, or cocoa to milk.

Buttermilk is cultured, which means that a lactic acid-producing bacterial culture (from milk sugar) is added to freshly pasteurized (milk that has gone through the pasteurization process which destroys harmful bacteria) skim or partially skimmed milk to produce the buttermilk. It is much thicker than skim milk.

Dry whole milk is pasteurized whole milk with the water removed. It has limited retail distribution, but is usually distributed to chocolate and candy manufacturers.

Nonfat dry milk is made by removing nearly all of the fat and water from pasteurized milk. It contains about half the calories of whole milk. Some instant nonfat dry milk is fortified with vitamins A and D.

Evaporated milk is prepared by heating homogenized whole milk under a vacuum to remove half of its water, sealing in cans, and thermally processing it. When mixed with water, evaporated milk's nutritive value is about the same as whole milk.

Sweetened condensed milk is a concentrated canned milk prepared by removing about half the water from whole milk. It is used often in candy and dessert recipes and has at least 40 percent sugar added to help preserve it.

Source: United States Department of Agriculture, *Home and Garden Bulletin* No. 201, "How to Buy Dairy Products," U.S. Government Printing Office: 1978 pp. 5-8.

Figure 12.2

Eighty percent of the eggs in a particular carton must meet the particular grade standard for which the carton is labeled. The other 20 percent allows for differences in storage and in inspection graders. Figure 12.3 identifies appropriate uses of each grade of eggs.

Appropriate Uses of Each Grade of Eggs

Grade	Use
AA	Poaching, frying
A	Baking, frying, hard cooking
B	Scrambled, omelettes, or in baked goods
C	Usually not available for consumers to purchase

Figure 12.3

In addition to grades, eggs also are classified according to weight. The weight categories are determined by the minimum weight per dozen eggs. The classifications of weight are as follows:

• Jumbo	30 ounces per dozen
• Extra Large	27 ounces per dozen
• Large	24 ounces per dozen (most recipes are based on this size)
• Medium	21 ounces per dozen
• Small	18 ounces per dozen
• Peewee	15 ounces per dozen

The grade and size of eggs are marked on the egg carton. It is important to remember that although both size and quality are marked on the carton, one is not related to the other. Any size of eggs may be any grade.

Fill-of-Container

The standards of ***fill-of-container*** were established to help prevent misrepresentation of product packaging. The standards may vary from one product to another. Cereal and other solid foods must be filled to the maximum level of the container without crushing or breaking occurring. Many cereal boxes state that the contents may have settled during shipping or storage making the box appear to be less than full when opened. According to the USDA definition of fill-of-container, unless defined by FDA regulations, USDA grades recommend that cans be filled as full as possible without damaging the quality of the food product.

LABORATORY EVALUATION METHODS FOR FOOD PRODUCTS

Laboratory evaluation methods for food products include physical and chemical properties. Various organizations set standards for evaluating food products and their functions. Examples of these organizations include the FDA, USDA, United States Public Health Service, National Marine and Fisheries Bureau of the United States, Department of Commerce, the FTC, and the Consumer Products Safety Commission.

Physical Properties

Physical properties refer to the principal physical characteristics of a substance or food determined by the senses. These characteristics can be affected by other substances. Physical properties of food include those that can be determined with the senses, such as color, flavor, smell, and texture, as well as the product's boiling and freezing points, solubility, fluidity, plasticity, and melting point. The physical properties of various foods have an effect on their preparation both at home and commercially.

The sensory characteristics of food have a major influence on food consumption. The senses of sight, taste, smell, and touch serve as evaluation tools for foods. Foods also can be evaluated by a combination of factors including flavor (smell and taste), texture (kinesthetics), and appearance (size, shape, and color). The following are characteristics that can be evaluated with the senses:

- Color should be retained. Too much water or heat can dull the color of the product. Color is often added to foods to improve appearance.
- Texture refers to the way the food feels to the touch and in the mouth.
- Flavor is a combination of smell and taste. Smell refers to the hundreds of aromas. Taste refers to the sensations of the taste buds on the tongue being either sweet, salty, sour, or bitter.
  - Sweetness (sugar) is perceived on the tip of the tongue.
  - Saltiness (table salt) is perceived on the tip of the tongue and on the roof of the mouth.
  - Sourness (lemon juice) is perceived on the tip of the tongue, sides of the tongue, and on the hard palate.
  - Bitterness (soda) is perceived toward the back of the tongue.

Several types of flavorings change or alter the original flavor of foods. Flavorings or flavor enhancers used include the following:

- monosodium glutamate
- extracts (liquid flavorings)
- herbs (parsley, basil, and oregano)
- spices (cinnamon, nutmeg, and pepper)

Monosodium glutamate is a flavor intensifier or enhancer that has little or no flavor of its own. It is high in sodium and should be used sparingly. ***Extracts*** are oils from aromatic plants stored in alcohol. The extract flavorings must be stored tightly covered to minimize the loss of the volatile flavoring compounds. Examples include peppermint extract, lemon extract, and vanilla extract. Spices and herbs come from various parts of certain tropical plants. ***Herbs*** come from the leaves of plants while ***spices*** come from various parts of the plants. Herbs also can be in the form of herb seeds. Figure 12.4 shows types of herbs.

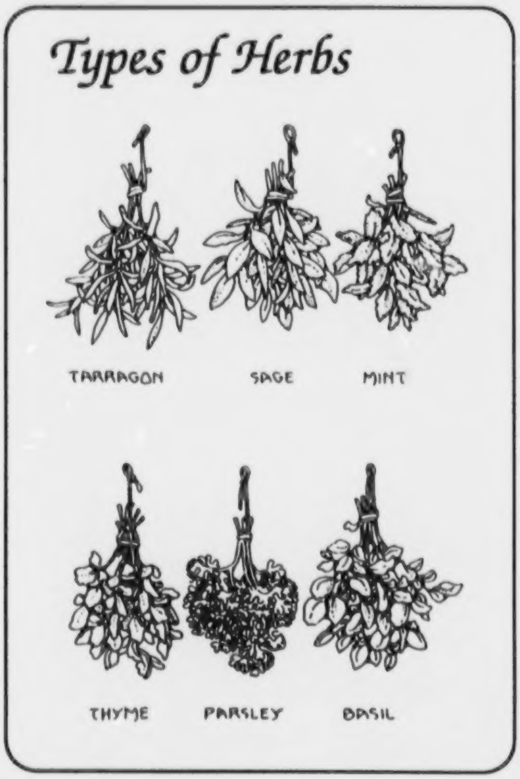


Figure 12.4

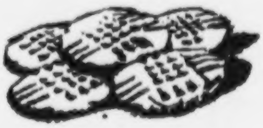
The ***freezing point*** refers to the temperature at which water changes from a liquid form to a solid form. Different products may have different freezing points due to different water and ingredient concentrations. Salt water has a lower freezing point than fresh water. A salt solution has a lower freezing point than a sugar solution when both have the same degree of concentration. In other words, the freezing point of a solution containing four cups of liquid and one cup of salt will be lower than the freezing point of a solution of four cups of liquid and one cup of sugar. The freezing point of sherbet is lower than that of ice cream because sherbet has a higher sugar content than ice cream.

The ***boiling point*** refers to the temperature at which water changes from a liquid to a gas. As with the freezing point, the boiling point depends on the ingredients of the product. For example, the higher the concentration of sugar in a product, the higher the boiling point will be. Heating a sugar solution until it boils is one way to determine the sugar concentration level of the product. Certain candies must have a certain concentration of sugar. The boiling temperature is a way to determine if the candy is done. The boiling point also is affected by altitude and barometric pressure. The higher the altitude, the lower the boiling point. More information regarding the boiling point can be found in Chapter Sixteen.

Solubility refers to the amount of a product that will dissolve in 100 grams of a liquid at a certain temperature to form a saturated solution. A ***saturated solution*** is one that has dissolved the maximum amount of a product that it normally can under a certain set of conditions.

Fluidity refers to a product's ability to flow or move without changing shape or separating. Water is very fluid, while molasses is much less fluid. The fluidity of water is much greater than the fluidity of molasses.

Plasticity refers to the ability of a product to change from one state to another or to be shaped, manipulated, or molded. Examples include the changes in cookie dough, pie crust, bread dough, and other yeast products. In fats, plasticity refers to the ability of the fat (such as shortening) to maintain its shape when exposed to slight pressure.



The ***melting point*** of a product refers to the temperature at which a solid substance turns into a liquid form. For example, fat melts to become oil. Different products have a particular melting point, and this melting point can be used as a means of identification. It is used often as a measure of purity because impurities, or substances not desired in a product, lower the melting point of a product.

Chemical Properties

Chemical reactions occur when two chemicals interact and the result is a change in both chemicals. ***Chemical properties*** refer to both the basic characteristic traits of a product and its chemical reactions when it is mixed with another product, heated, or frozen. Some of the chemical changes that take place when food is prepared include the following:

- hydrolysis of sugars and starches
- fermentation of carbohydrates
- cooking of starches
- browning
- rancidity
- hydrogenation
- coagulation
- effects of acids, bases, salt, and oxidation

Hydrolysis is a chemical process in which a substance reacts with water and is changed into one or more other substances. Examples include the breakdown of sucrose (table sugar) into a 50/50 mixture of glucose (blood sugar) and fructose (fruit sugar), the breakdown of lactose (milk sugar) into glucose and galactose (another milk sugar), or natural fats into glycerol (food fat) and fatty acids.

Fermentation refers to the process of yeast cells and bacteria transforming sugars into carbon dioxide and alcohol, which cause the volume of the dough to increase. It is used in doughs for bread, rolls, and cakes. The process of fermentation is influenced by room temperature and the concentrations of sugar, salt, and yeast in the product.

Starches (carbohydrates) are cooked in order to obtain their full thickening capabilities and to develop flavor. Thickening is accomplished when enough water and heat is added to the starch granule for gelatinization to occur. ***Gelatinization*** refers to the process in which starch, water, and heat are combined causing the starch particles to absorb the water and swell. Gelatinization causes the starch to take on the appearance of thickening. Dry heat affects starches through the process of dextrination. When starch or foods containing starch are heated with dry heat, dextrins are formed. The carbohydrate compounds formed, or ***dextrins***, have a very sweet taste.

Browning enhances the color and flavor of foods. Browning can be caused by two factors: caramelization and the Maillard reaction. ***Caramelization*** occurs when any of the sugars are heated beyond their melting points. As the heat pulls the water out of the sugar, a series of reactions occur causing the sugar molecules to turn brown. The ***Maillard reaction*** occurs when an amino acid (protein) reacts with a sugar, such as lactose, maltose, or glucose, to produce a brown color. The Maillard reaction occurs during cooking as the temperature and cooking time increase. The Maillard reaction can occur in some foods at room temperature. The process occurs faster during the cooking process. The Maillard reaction can occur with dried milk that has been stored for a long period of time. The dried milk will begin to deteriorate and turn brown.

Rancidity is unique to fats and their spoilage. A fat is considered rancid when the flavor and odor have deteriorated due to exposure to heat or air.

Hydrogenation is the solidification of fluid oils and soft fats. Hydrogen added to unsaturated fatty acids causes them to become more saturated and to solidify.

Coagulation occurs when a substance changes from a fluid state to a thickened state due to the change in the protein of the substance. The change in the protein occurs through such processes as heat and the addition of acids or alkalies. Egg whites coagulate when exposed to heat by changing from a transparent mass to a soft white mass. Cheese is formed through the coagulation of protein in milk by lactic acid (milk sugar) bacteria or certain enzymes.

Acids are compounds that have a strong, sour taste. Examples of acids include lemon juice, vinegar, and cream of tartar. Organic acids are composed of hydrogen, oxygen, and carbon and can be found in foods. Acetic acid gives vinegar its taste. Most vinegar is produced from ethyl alcohol using acetobacter bacteria to convert the alcohol to vinegar. Citric acid is found in citrus fruits, malic acid is found in pears, apples, and other fruits and vegetables, and tartaric acid is found in grapes. All colors in foods are intensified by the addition of acids. Acids added to cut fruits can slow the oxidation process or browning of the fruit.

Bases are compounds that can react with an acid and form a salt. In water, a base will have a bitter taste. Baking powder and baking soda are examples of bases. If bases are present in excess, they can change the white pigments of flour to a yellowish color and increase the Maillard reaction. To prevent this problem, bases are combined with acids in food production. Examples of foods containing acids that can be used in this process include buttermilk, yogurt, molasses, and brown sugar.

Bases are used with acids as leavening agents in baked products such as breads. A leavening agent adds air to a mixture increasing the mixture's volume and lightness. Leavening agents are discussed in greater detail in Chapter Seventeen. Bases added to foods dull all food colors except green. Table 12.1 summarizes the effects of acids and bases in vegetable cookery.

Effects of Acids and Bases on Vegetable Cookery

	Food Source	Color	Texture	Nutritive Value
Acids	Lemon juice, vinegar, cream of tartar	Intensifies all colors except green	Resists softening firm textures	Favorable to most nutrients except vitamin C– Vitamin C is more stable in oranges and tomatoes
Bases	Baking soda, baking powder	Dulls all colors except green	Softens cellulose	Increases destruction of thiamin and ascorbic acid

Examples

	Peas (green)	Red cabbage (red)	Carrots (yellow)	Cauliflower (white)
Acid	Dulls	Intensifies	Intensifies	Intensifies
Base	Intensifies	Dulls	Dulls	Yellows

Table 12.1

Salt is the only rock directly consumed by human beings. Salt has been used for centuries as a preservative for meats, poultry, and other products. A ***microbe*** is a microscopic (can only be seen with a microscope) organism or bacterium that causes disease. Salt may be added to processed foods to prevent spoilage from bacteria, molds, fungi, and yeast. Salt used as a preservative also helps to extend the shelf life of the product and to protect the product's natural color and flavor.

Oxidation occurs when foods are exposed to air. ***Oxidation*** refers to the addition of oxygen and the reduction of hydrogen when a food product is exposed to air and results in food spoilage. When the surface of cut fruits and vegetables turns brown, it is a result of oxidation.

Summary

- ☐ All meat and poultry sold in interstate or foreign commerce must be federally inspected for wholesomeness and truthful labeling.
- ☐ The Pure Food and Drug Act was intended to prevent the manufacture, sale, or transportation of foods, drugs, and liquors that are adulterated, falsely labeled, poisonous or deadly, or harmful.
- ☐ The FDA is responsibile for the safety and quality of all foods involved in interstate commerce with the exception of meat, poultry, and eggs. The FDA has the shared responsibility with other agencies to enforce the safety and sanitation regulations of certain products.
- ☐ The United States Department of Agriculture enforces quality inspections for grain, vegetables, meat, poultry, milk, and eggs that are produced in the United States.
- ☐ The United States Public Health Service has no power to enforce laws, but it provides state and local governments with recommendations for establishing food ordinances.
- ☐ Standards of identity have been established to define the composition of the most commonly used food products in the United States.
- ☐ Standards of quality are the minimum requirements for the quality of food products. Characteristics with standards include color, tenderness, and freedom from defects (of canned foods).
- ☐ The standards of fill-of-container were established to help prevent the misrepresentation of product packaging.
- ☐ Physical properties refer to the principal physical characteristics of a substance or food determined by the senses.
- ☐ Chemical properties refer to both the basic characteristic traits of a product and its chemical reactions when it is mixed with another product, heated, or frozen.
- ☐ Solubility refers to the amount of a product that will dissolve in 100 grams of a liquid at a certain temperature to form a saturated solution.
- ☐ Salt may be added to processed foods to prevent spoilage from bacteria, molds, fungi, and yeast.

Vocabulary

acids
adulteration
Agricultural Marketing Act
Agricultural Marketing Service
bases
boiling point
British Food and Drugs Act
Bureau of Alcohol, Tobacco, and Firearms
caramelization
Centers for Disease Control
chemical properties
choice grade
coagulation
Delaney Clause
dextrins
Egg Products Inspection Act
Environmental Protection Agency (EPA)
extracts
Fair Packaging and Labeling Act
Federal Food, Drug, and Cosmetic Act
Federal Grain Inspection Service
Federal Trade Commission (FTC)
fermentation
fill-of-container
fluidity
Food Additives Amendment
Food and Drug Administration (FDA)
foreign commerce
freezing point
gelatinization
grading
herbs
hydrogenation
hydrolysis
interstate commerce
intrastate
Kenyon Amendment to the Wiley Act
Maillard reaction
McNary-Napes Amendment to the Wiley Act
Meat Inspection Act
melting point
microbe
Miller Pesticide Amendment
monosodium glutamate
National Marine Fishery Service
oxidation
Pasteurized Milk Ordinance
physical properties
plasticity
Poultry Products Inspection Act
Prime grades
Pure Food and Drug Act
quality
rancidity
recalls
salt
Seafood Inspection Amendment to the Wiley Act
saturated solution
select grade
solubility
spices
standards of identity
standards of quality
United States Department of Agriculture (USDA)
United States Public Health Service
Weight and Measure Amendment to the Wiley Act
Wholesome Poultry Products Act
yield

Review

1. What is the responsibility of the Food and Drug Administration?
2. What two factors do the grading of beef represent?
3. What are the grades for pork?
4. How do egg grades differ from egg weights?
5. Is poultry grading optional or mandatory? Why?
6. What can happen to the color of foods when they are exposed to water or heat?
7. How is milk graded?
8. Why were standards of fill-of-container established?
9. What are the four basic tastes and how does the tongue perceive them?
10. How should extracts be stored?
11. What factors can affect the boiling point of a solution?

Critical Thinking

Research one of the food laws. What issue or issues led to the law's passage? What amendments have been made to the original act and why? If this law or act did not exist, what problems could occur? How does this law affect you personally?

Research a particular agency that oversees food quality and wholesomeness in the United States. When was the agency established? What factors led to the development of this agency? What are its primary responsibilities? How many employees does it have? Which laws or ordinances is this agency responsible for enforcing?

13

Forms of Food Products

ESSENTIAL ELEMENT

- ☐ Determine the effect of various forms of ingredients on food products.(j3B)

OBJECTIVES

- ☐ Evaluate the various forms of food products.
- ☐ Compare forms of food product evaluation.

All fresh or raw foods are perishable to some degree. ***Perishable*** foods are those that can spoil easily. The rate of perishability can vary from one food item to another. Foods are processed for several reasons. One reason is to slow their deterioration so the food can be eaten at a later date. Other reasons are to improve flavor and digestibility, to kill harmful organisms and bacteria, and to make foods more convenient.

FOUR BASIC FORMS

Food products are available in four basic forms. These four forms include raw, dehydrated, canned, and frozen. Each has its advantages and disadvantages. The forms of products a person purchases may be chosen because of storage space, preferences, and available cooking facilities. Most processed foods or convenience foods are more costly than unprocessed foods. The best product form for one person to purchase may not be the best product form for another to purchase.

Raw Foods

Raw foods begin to lose quality soon after they are harvested. They must be properly stored before they begin to deteriorate and lose their flavor, crispness, and quality. Vegetables that are fresh-stemmed (celery, alfalfa sprouts, and broccoli), leafy (lettuce, cabbage, and kale), and many root types (carrots, radishes, and rutabagas) should be stored in a refrigerator or a cool area with high humidity. They also should be covered to reduce evaporation. Some vegetables should not be refrigerated at all because refrigeration increases their deterioration. Examples of these vegetables include onions, potatoes, and some legumes.

Raw fruits should be stored at temperatures of 32°F to 35°F to retain quality. Fruits stored in temperatures above 35°F will continue to ripen, soften, and spoil more quickly. Bananas should be stored at room temperature and not in the refrigerator. Refrigerating bananas makes them turn black.

Raw fruits and vegetables should be washed thoroughly before they are eaten or cooked. Many hands touch products at various stages of harvesting, production, and marketing. The skins should be left on for the best nutrient retention. Not only are some nutrients found in the skins of fruits and vegetables, but the skins also help retain the nutrients inside.

Table 13. 1 includes various information about a few fruits and vegetables that can be purchased raw.

Dehydrated Foods

Dehydrated foods are created through the process of dehydration. ***Dehydration*** is a method of food preservation in which most of the water is removed from the food. The following are methods of dehydration.

- mechanical dryers
- vacuum
- direct application of heat supplied through conventional gas and electric heat, infrared, and convection
- microwave methods for herbs and flowers
- superheated steam
- inert gas
- dehydrofreezing
- freeze-drying

Dehydrated foods require little space for storage and have a relatively long shelf life. ***Shelf life*** refers to the length of time a product can remain on the shelf before it begins to deteriorate and become unsafe to eat. When a food product is dried, the size of the product is reduced. The reduction is often as much as one-fourth of the original size. Examples of dehydrated food products include nonfat dry milk, soup mixes, spices, and instant coffee. Dehydrated products should be stored in a dry, cool place to prolong shelf life.

Meat, fish, and poultry must be fresh before they are dehydrated. Meats dried as jerky and smoked meats are examples of dehydrated meats. Most fruits and vegetables require some type of treatment before dehydration to retain color and to speed the drying time. Dried or dehydrated vegetable products, such as potato flakes, do not need to be refrigerated.

Dried fruits can be used in the following:

- cakes
- candies
- frozen desserts
- pies
- puddings

Canned Foods

The canning process was developed at the beginning of the nineteenth century and flourished in this country after the Civil War. ***Canning*** is a food preservation process that sterilizes the food product and the liquid in which it is stored in order to kill harmful

Fruits and Vegetables Information				
	Blueberries	**Potatoes**	**Corn**	**Green Beans**
Selection	They should be firm, plump, and deep blue with a powdery gray coating called the bloom. Stained or leaky containers should be avoided.	Potatoes should be firm, fairly smooth, and well shaped. They should be clean but not washed. Avoid potatoes with sprouts, decay, or green areas.	Corn should have fresh green husks and plump, juicy looking kernels.	They should be smooth with crisp pods and almost invisible seeds. Green beans should be green and blemish-free.
Market Season	May through July	April through October	May through August	April through December
Storage	Keep covered in refrigerator for up to two weeks.	Store in a cool, dark, well-ventilated bin. They should not be washed before storage, and they should not be stored in the refrigerator. Refrigerator storage causes the starch to change to sugar, making it undesirably sweet, and it causes it to darken when cooked.	Corn does not store well. A person should buy only what can be cooked and eaten the same day.	Green beans can be refrigerated in plastic bags for four to seven days.
Nutritional Information	Blueberries are a source of vitamins A and C, potassium, and calcium.	The largest concentration of vitamins and minerals is found just beneath the skin. The potato is most nutritious when cooked and eaten with the skin on or at least cooked with the skin on and peeled just before being eaten. Potatoes contain vitamin C, phosphorus, and potassium.	Corn is a good source of fiber, vitamin B6, vitamn A, and potassium.	Green beans supply vitamins B and A , potassium, and magnesium.

Source: Texas Department of Agriculture

Table 13.1

bacteria and to extend the life of the product for several years. The canning process has undergone many changes since it began. Some changes include increased nutrient retention, improved flavor, and established regulations for the canning processes.

Molds, yeasts, and bacteria are organisms that cause food spoilage. They are always present in the soil, air, and water. Raw foods contain enzymes that have the potential to produce negative effects on the food's flavor, color, and texture. During the canning process, the temperature must be high enough for a long enough period of time to sterilize the product by destroying the molds, yeasts, bacteria, and enzymes.

Two categories of canned food products are low-acid and high-acid foods. ***Low-acid foods*** have a pH level of 4.5 or greater and must be heated at a higher temperature and for a longer period of time than high-acid foods. The ***pH level*** refers to the degree of acid or alkaline in a product. The pH values range from 0 to 14 with 7 representing neutrality. Values below 7 indicate increasing acidity, and values above 7 indicate increasing alkalinity. Alkaline is a water-soluble substance that neutralizes acid. Acid is any compound that can react with a base to form a salt.

High-acid foods have a pH level of 4.5 or less and have an acidity level that prevents the growth of most organisms to some degree. Because high-acid foods prevent the growth of harmful organisms, they require less heat than the low-acid foods. Some high-acid foods include tomatoes, apples, and grapefruits. Examples of low-acid foods include corn, fish, and milk.

Raw foods provide more nutrition than canned foods because many nutrients are destroyed by the high temperatures used during the canning process. The nutritive value between canned foods and cooked raw products is very similar. Canned foods, however, are more nutritious than dehydrated foods. Water-soluble vitamins and minerals (those that are dissolved in liquid) are the nutrients affected most by the heat and the liquid in which the food is stored. Thiamin (vitamin B_1) and ascorbic acid (vitamin C) are most affected by the heat of the canning process. Some of the nutrients lost in the fluid can be retained by using the liquid during the cooking or heating process.

The quality and flavor of a particular canned product may vary for several reasons. The initial raw product used and the size of the container are two variables. Some food processing plants may use their best quality raw products in the products bearing their own label and use lower quality raw products in their off-brands. This may account for a difference in flavor and quality from one brand to another even though the actual canning process may be identical.

The size of the container can produce a variation in the flavor of a product. The heating time required for canned products is based on the size of the container in which the food will be canned. Foods canned in large containers are heated for longer periods of time than the same foods canned in small containers. The difference in heating time affects the quality of the final product.

The nutrient information on labels reflects an assumed nutrient loss of approximately 10 percent. Nutrient loss also can be affected by storage conditions if temperatures are greater than 80°F. Other factors affecting nutrient loss during the canning process include light sensitivity, nutrient interactions, oxygen concentration, and acidity.

Canned fruits can be used in the following:

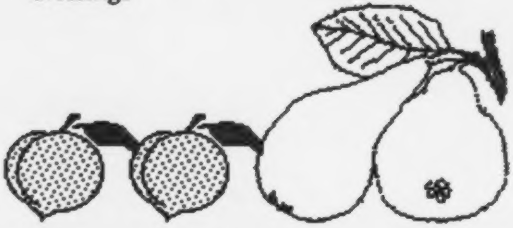
- cakes
- pies
- tarts
- salads
- gelatins
- cobblers
- turnovers

Food canned commercially is done under tightly controlled and sanitary conditions. Most commercially canned foods have a shelf life of two or more years. Certain conditions or factors can limit the shelf life of canned food products such as rusting and corrosion of the can, high storage temperatures, and, in rare occasions, botulism. Botulism is a food poisoning found in improperly canned foods that can result in death.

Cans are made primarily of tin. The interior of most cans are lined with thin enamel to protect the food. The can itself may tend to rust over time. Severe rust can cause tiny holes in the can which allow spoilage in. If the seams of a can become rusted, the can should be discarded. When cans fall or are crushed during shipping, similar container problems can occur.

Corrosion can occur with cans containing certain food products. High-acid foods such as tomatoes can have a chemical reaction with the metal of the container. Over a period of time, the chemical reaction can cause the taste and texture of the food product to change. This chemical reaction eventually lowers the nutritional value of the food product. High-acid canned foods include the following:

- juices such as tomato, orange, lemon, lime, and grapefruit
- tomatoes
- pineapples
- grapefruits
- mixed fruit
- apples
- peaches
- plums
- pears
- pickles
- sauerkraut
- foods treated with vinegar-based sauces or dressings



Low-acid canned foods may not be as corrosive as high-acid foods. They can be stored for two to five years. Low-acid canned foods include the following:

- meat and poultry
- stews
- vegetable soups except tomato
- noodle and pasta products
- potatoes
- corn
- carrots
- spinach
- beans
- beets
- peas
- pumpkin

Storing canned goods in temperatures above 100°F is harmful. The chance of spoilage increases sharply as storage temperatures increase. A special manufacturing process is used for canned goods produced to be sold in the tropics. This process makes them able to withstand the high temperatures.

Botulism is poisoning caused by a toxin produced by botulinus bacteria that may be found in improperly canned or preserved foods. Botulism is the worst problem that can be encountered with canned goods. Eating foods contaminated with botulism causes food poisoning. Symptoms of botulism poisoning include nausea, blurred vision, and respiratory stress. This poisoning is often fatal. Warning signals that may indicate food spoilage or contamination include the following:

- leaking container
- bulging container
- foul odor
- badly dented container
- cracked jar
- jars with loose lids

If botulism is suspected, a person should not taste the food. The product should be sealed in a plastic bag and should be reported to the local health officials. If the food is eaten accidentally and someone becomes ill, a doctor should be contacted immediately. Figure 13.1 indicates wise use of canned goods.

Frozen Foods

Freezing preserves foods in a manner that has little effect on the product's color, flavor, texture, and nutritional value. Unlike canning, freezing does not sterilize the product but does stop the growth of potentially harmful molds and bacteria.

Frozen food processing, storage, and distribution have advanced a great deal in recent years and can now be produced at modest prices. Most foods can be stored in their frozen state for approximately twelve months without significant losses of quality and nutrients.

Wise Use of Canned Goods

- Store canned goods in a cool (below 85°F), clean, dry place.
- Low-acid canned goods may be stored for two to five years.
- High-acid canned goods may be stored for twelve to eighteen months.
- Canned ham may be stored in the refrigerator for six to nine months.
- Boil all home-canned foods before serving.

Figure 13.1

To ensure the quality of frozen food products for the consumer, the following trade organizations known as the ***Frozen Food Roundtable*** established the *Code of Recommended Practices for the Handling and Merchandising of Frozen Foods*, which outlines recommended handling practices for frozen food products from the raw material to the consumer. The Frozen Food Roundtable includes the following associations:

- American Association of Meat Processors
- American Frozen Food Institute
- Commercial Refrigerator Manufacturers Association
- Food Marketing Institute
- Frozen Potato Products Institute
- International Association of Refrigerated Warehouses
- Interstate Carriers Conference
- National American Wholesale Grocers Association
- National Broiler Council
- National Fisheries Institute
- National Frozen Brokers Association
- National Frozen Food Association
- National Frozen Pizza Institute
- National Grocers Association
- National Prepared Frozen Food Association
- National Restaurant Association

There are no federal regulations concerning handling procedures for frozen foods. These associations developed the following voluntary operating practices based upon extensive research, new technologies, products and codes, as well as the numerous advances in frozen food handling and merchandising.

Foods used for the freezing process must be high-quality, go through the correct processing procedures, be packaged in adequate materials, and be appropriately stored and rotated ***FIFO*** (first in, first out). ***Lot numbers*** are assigned to each batch or lot that is processed at one time under the same conditions. Information regarding temperature used, length of time for processing, and other conditions are recorded for each lot number and placed on file with the manufacturer. Lot numbers are recorded on the product containers for identification and rotation purposes. Temperatures of 0°F or lower must be maintained at all times except when absolutely necessary and for only a brief period of time. Some spoilage organisms can grow at 20°F. Chemical reactions also occur in this temperature range because of the high concentration of some ingredients in the frozen product. It is important to maintain the air temperature around the food at 0°F or below. Fluctuations in temperatures can have detrimental effects on frozen products.

Freezing requires extremely sanitary conditions as well as suitable containers. The freezing process should allow the product to pass through the temperature range of 23°F to 30°F to reach a frozen state in as short a time as possible. Food products should then be placed in appropriate containers, transported to a cold warehouse, and stored in temperatures of 0°F or lower and allowed to remain there for an adequate time to ensure an even temperature throughout the product. The various freezing methods are listed in figure 13.2.

Containers used for storing products after the freezing process should have the following characteristics:

- puncture resistance
- good quality to prevent contamination and minimize dehydration
- resistance to low temperatures
- no odor
- nonstick finish
- ease in identification
- rotation symbols and lot numbers

Warehouse storage and transportation from the warehouse to the retail establishment are very critical to the safety of the frozen product. To avoid potential deterioration of frozen products, warehouse storage temperatures should remain at or below 0°F even during loading, unloading, or any other procedure that may allow warmer air to enter the storage area. Thermostats may need to be lowered considerably to maintain the 0°F temperatures to reduce the heat gain and dollar loss resulting from the frozen product's exposure to unsafe temperatures.

All vehicles used in the transportation of frozen foods should adhere to the following standards:

- They should be properly insulated.
- Vehicles should be equipped with appropriate refrigeration equipment to maintain the product temperature at 0°F or below.
- They should have a working thermometer in an easily accessible location to enable workers to monitor the air temperature inside the vehicle.
- Tight-fitting doors and suitable drain hole covers should prevent air from escaping.
- Vehicles should be clean and free from dirt, debris, and offensive odors that could be absorbed by the products. They should be

Freezing Methods

❄ **Air Blast**
Individual pieces of food, often referred to as individually quick frozen (IQF), are placed on a conveyor belt and transported through a tunnel where they are blasted with cold air and are frozen. Dehydration of 1 percent usually occurs.

❄ **Direct Placement Into Frozen Storage**

❄ **Liquid Nitrogen**
This procedure is similar to the air blast method except liquid nitrogen is blown over the food product instead of air.

❄ **Liquid Freon**
This is the fastest freezing method, but it also may be the most costly. Freon is eventually released from the food and can cause damage to the atmosphere.

Figure 13.2

free of potentially harmful substances that could contaminate the frozen products.

- Trucks must be precooled to 0°F or below before loading.
- Air circulation must be provided to maintain a temperature of 0°F or below throughout the truck at all times.
- The vehicle's refrigeration unit must be kept running and the doors of the vehicle should be closed at all times when the truck is not being loaded or unloaded.
- The thermostat should be set to maintain the air temperature at 0°F at all times.

John's Frozen Foods

Product temperatures should be measured or checked upon receipt at the retail establishment. A product with a temperature of 10°F or higher should be accepted only upon approval of the manager. Once the product is approved for receipt, it should be placed in storage or taken to the display case as quickly as possible. Both the storage facilities and display cases should be capable of maintaining an air temperature of 0°F or below. A thermometer should be located in the warmest part of each storage facility and display case to measure the air temperature. Temperatures should be checked frequently. Storage facilities should have adequate air circulation between products. The amount of warm air allowed in the facility should be reduced as much as possible to retain the 0°F air temperature.

The Frozen Food Handling Code recommends four methods for defrosting frozen foods in a food service establishment. Only the amount of food necessary or required for immediate use should be removed from the freezer. Frozen food products should be defrosted by using one of the following methods. Any other method of frozen food defrosting is not considered safe and is not recommended. Frozen food should be defrosted in the following ways:

- according to the manufacturer's instructions
- in a refrigerator with a temperature not greater than 45°F
- under drinkable running water at a temperature not greater than 70°F
- in a microwave oven or in conventional cooking equipment as long as the thawing and cooking process are continuous

FOOD PRODUCT EVALUATION

Nutritional changes take place during all stages of food processing. Some processing techniques enhance the nutritional value of foods while others may decrease the nutritional value. Techniques used for milling rice and wheat destroy the thiamin, riboflavin, niacin, and other nutrients. After processing, these products are enriched with thiamin, riboflavin, niacin, and other lost nutrients. In other words, the nutrients lost during the first stages of processing are added during the later stages of processing. While these nutritional enrichments are considered good, some additives are considered bad. Many convenience foods are often criticized because of the high amounts of sugar, fat, sodium, and calories added to the original product.

Today, nutrient losses in foods that are commercially processed are low. Some research shows losses to be as little as 25 percent. It is possible to have a loss of 25 percent or less, but a loss of 60 to 75 percent is more common. The type of processed foods purchased and the handling of the foods after they are purchased make a difference in the amount of nutrient loss.

Raw foods may be more nutritious, but spoilage is one of their disadvantages. Canning is an excellent method for preserving foods, but nutrients are lost during the canning process. The nutrients affected most in the order most easily destroyed are vitamin C, thiamin, and riboflavin. The freezing process does not destroy nutrients, but some losses do occur during the steps to prepare the foods for freezing. The nutrient destroyed most often is vitamin C. Vitamin C is destroyed when the tissue of the product is destroyed and exposed to air. Vitamin C can be retained, however, if the product is left whole and is handled as little as possible.

Dehydrated foods have the characteristic of eliminating microbial spoilage and decreasing the weight and size of the product. Microbial spoilage is caused by microbes. Microbes are microscopic organisms that cause disease. Microbes need water to grow. Water is eliminated during the dehydration process. Sulfur dioxide, a preservative, is often added during the drying process to prevent browning of the food product. The sulfur dioxide helps preserve and retain the vitamin C, but it destroys the thiamin.

Many individuals have become dissatisfied with the additives used in convenience foods. They have turned to what they consider to be more natural foods. Health food store sales have increased with the sale of such products as natural peanut butter containing only peanuts. The major food manufacturers have responded to consumer demands by offering low-sodium soups, crackers, and drinks; sugar-free soft drinks and drink mixes; caffeine-free soft drinks; and low-sodium, reduced fat luncheon meats.

Summary

- ❑ All fresh or raw foods are perishable. The rate of perishability varies from one food item to another.
- ❑ Foods are processed to slow the deterioration rate so that the food can be eaten at a later date, to improve flavor and digestibility, to kill harmful organisms and bacteria, and to provide convenience.
- ❑ The four basic forms of food products available for purchase include raw, dehydrated, canned, and frozen.
- ❑ Dehydrated foods require little space for storage and have a relatively long shelf life.
- ❑ Molds, yeasts, and bacteria are organisms that cause food spoilage and are always present in the soil, air, and water.
- ❑ Freezing preserves food in a manner that has little if any effect on the product's color, flavor, texture, and nutritional value.
- ❑ Nutritional changes take place during all stages of food processing.
- ❑ Raw foods may be more nutritious, but spoilage is one of their disadvantages.

Vocabulary

canning
dehydration
FIFO
freezing
Frozen Food Roundtable
high-acid foods
lot numbers
low-acid foods
perishable
pH level
shelf life

Review

1. Most food products can be purchased in what four forms?

2. What are the benefits of processing foods?

3. What are two advantages of raw foods? disadvantages?
4. How are foods dehydrated?
5. What are two advantages to canning food products? disadvantages?
6. How do low-acid foods differ from high-acid foods in the canning process?
7. Frozen foods can be stored for approximately how long without significant losses in quality and nutrients?
8. What are three methods of freezing foods?
9. In what ways has the Frozen Food Roundtable influenced the frozen food industry?
10. Why is frozen foods warehouse storage and transportation from warehouse to retail establishment so critical to the safety of the frozen product?
11. What are the four methods identified as acceptable for defrosting frozen food products?
12. What nutrient is destroyed most often during the freezing process?

Critical Thinking

Make four apple pies using the same recipe. Make one using raw apples, one using canned apples, one with frozen apples, and one with dehydrated apples. Develop criteria for evaluating the pies before and after baking. What should you include in your criteria? Compare the appearance of the apples before placing them in the pies. What are the differences? After baking the pies, evaluate them again using the criteria for evaluation that you developed. Next, cut the pies and sample each. Draw some conclusions as you evaluate each pie. Summarize your findings in writing.

14

Manipulation of Food Products

ESSENTIAL ELEMENT

- ☐ Determine the effect of various manipulative procedures on the quality of selected food products.(j3C)

OBJECTIVES

- ☐ Explain the changes that take place in food products when they are mixed and kneaded.
- ☐ Identify methods of cutting foods and their effects on nutrient retention.
- ☐ Compare the processes of heat transfer during cooking.

Manipulation refers to the process of handling or treating a food product to develop a specific end result. Examples of manipulation procedures used on food products include mixing, beating, cutting, and cooking. Each procedure will result in a different effect on the food product.

MIXING AND KNEADING

Success in achieving a quality product not only involves the quality and proportion of the ingredients but also the method in which they are combined. In a flour mixture, the main goal is to evenly distribute the ingredients throughout the mixture. ***Mixing*** involves moving a spoon or similar utensil in a circular motion to combine the ingredients. Some products, such as muffins, require ingredients to be mixed only enough to be moistened while others, such as cake batters, require ingredients to be mixed rapidly and for a longer period of time in order to incorporate as much air as possible and to produce a batter that is smooth and creamy.

Gluten is a tough, sticky substance that is developed from wheat flour. Flour can be made from barley, buckwheat, corn, oats, rice, rye, and wheat, but only wheat has the right amounts of plant protein to develop gluten. Flour contains a high proportion of starch as well as two proteins: glutenen and gliadin.

Liquid must be added to these proteins for the gluten to begin forming. Gluten is formed by mixing the flour with a liquid and kneading or stirring. The mixture becomes elastic and sticky. The activation of the gluten allows the flour to stretch and hold the other ingredients, including gases, in a batter or dough form. The gluten is mixed to varying degrees depending on the product being created. The proper amount of mixing and manipulation of the gluten is extremely important to the final product.

Hand Mixing

Hand mixing involves moving a spoon or other similar utensil in a circular motion to distribute ingredients evenly. Muffin, biscuit, brownie, and pastry ingredients are mixed by the hand mixing method. This process introduces a small amount of air into the ingredients.

Two basic methods of hand mixing include the muffin method and the biscuit or pastry method. The ***muffin method*** requires mixing just until moist. It is described in figure 14.1. The batter is lumpy. The muffin method is used for making muffins, popovers, waffles, pancakes, most corn breads, and some loaf breads. The ratio of flour to liquid ingredients should be two to one.

Muffin Method Procedure

1. Sift dry ingredients together (flour, leavening, salt, and sugar) and add extra ingredients.
2. Mix liquid ingredients (eggs, milk, and melted or liquid fat).
3. Combine the liquid and dry ingredients by stirring only until the dry ingredients are moistened. The batter should appear lumpy.

Figure 14.1

Overmixing should be avoided but is easy to do with this method. Overmixing causes toughness, coarseness, tunnels, and peaks in the final product. The product will be less tender and may not brown properly.

The ***biscuit method*** or ***pastry method*** of mixing, described in figure 14.2, results in a dry dough mixture used for biscuits or pastries. The ratio of flour to liquid ingredients should be three to one.

Biscuit or Pastry Method

1. Sift dry ingredients (flour, leavening, and salt) and add extra ingredients.
2. Cut solid fat into the dry ingredients with a pastry blender (dough should resemble coarse cornmeal).
3. Add liquid ingredients.
4. Combine the liquid and dry ingredients and stir until all of the flour is moistened. Overmixing results in a tough product.
5. Place dough on a lightly floured board, knead ten to twenty times, roll out to one-half inch thick and cut as necessary.

Figure 14.2

Kneading is a process used with yeast breads and is done by folding the dough and pressing it with the heels of the hands. The dough is rotated a quarter turn, folded, and kneaded again. Kneading distributes the ingredients more evenly and develops flakiness. Overkneading develops too much gluten and results in a tough, compact product.

Yeast breads can be made by three basic methods; the straight-dough method, the sponge-dough method, and the batter method. In the ***straight-dough method***, all ingredients are combined and the dough is kneaded and set aside to rise. In the ***sponge-dough method,*** the yeast is combined with part of the liquid, flour, and sugar to make a batter. The batter is covered and allowed to rise in a warm place until light and bubbly. The remaining ingredients are added to make a stiff dough. In the ***batter method***, the dough is mixed and shaped but not kneaded. After shaping, it is allowed to rise only a short time. The finished product has a coarse, porous texture and tends to dry out quickly.

Muffins, biscuits, and yeast breads are made by the hand mixing method. Sweet yeast breads are typically made by mechanical mixing.

Mechanical Mixing

Mechanical mixing involves a mechanical device such as a hand-held mixer, table mixer, bench mixer, floor mixer, or blender that has an agitator that moves in a circular motion to distribute ingredients of a product evenly. Mechanical mixing produces a more thoroughly mixed product than hand mixing. Hand mixing may produce a somewhat lumpy batter or dough while mechanical mixing produces a creamy batter or dough. The process typically introduces more air into the ingredients than hand mixing.

Mixers may be either hand held, floor models, bench models, or table models. The ***floor model mixer*** can hold thirty to sixty quarts and is used for mixing and blending ingredients or for adding air to a mixture. The ***bench model mixer*** can hold 12 to 20 quarts and the ***table model mixer*** can hold 5 quarts. These mixers are used for mixing, beating, or creaming ingredients for cakes, batters, doughs, and pastries. A ***hand-held mixer*** can be used to mix ingredients in almost any size container and is used more often in home cooking. The hand-held mixer is not as powerful as the other types of mixers and cannot introduce as much air into a product. All mixers can be used for mixing, creaming, or beating ingredients for cakes, batters, doughs, pastries, or meringues.

Mixers may have several operating speeds and may use a variety of beaters or ***agitators*** for specific purposes. A ***flat beater*** is used for general mixing. It is never used for heavy doughs. A ***wire whip*** is used for incorporating air into light mixtures but not for heavy mixtures. A ***dough hook*** is used for mixing heavy doughs that require a folding and stretching action. A ***pastry blade*** is used for combining shortening and flour with a cutting action as for biscuits, pie crusts, or shortcakes.

Blenders are used for high-speed blending or mixing of meat, fish, vegetables, fruits, or beverages. ***Food processors*** are used to chop, slice, puree, and grate products at a high speed.

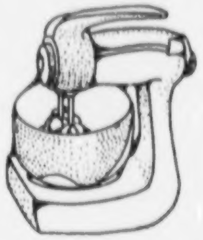
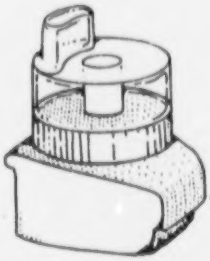
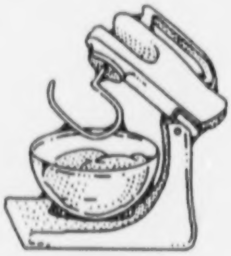


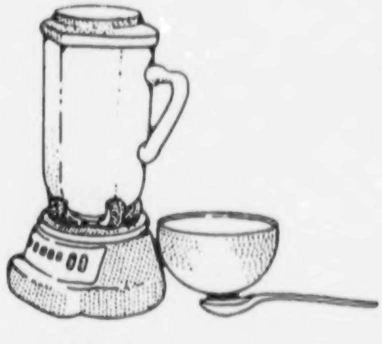
table mixer



food processor



dough hook



blender

Sweet yeast breads can be mixed using the mechanical mixing methods. ***Sweet yeast breads*** include sweet rolls, doughnuts, and Danish pastries. The dough has a higher proportion of sugar, shortening, and eggs to flour. Sweet yeast breads are sweeter, more tender, and less chewy than other yeast breads. They are also mixed by a different method than other yeast doughs.

The shortening, sugar, salt, and flavorings are creamed or mixed together until fluffy. Liquid or dry solids are added and the mixture is creamed again. Eggs are added one at a time and beaten on medium speed. Yeast may be softened and added to the milk mixture, or dry yeast may be mixed with the last addition of flour. The flour is added gradually and mixed thoroughly on low speed after each addition. Danish pastries are not kneaded. A temperature of 78°F to 82°F must be maintained while mixing the dough because of the low gluten content. Too much mixing causes the temperature to rise and the dough to become sticky and difficult to handle. Proper mixing results in a smooth elastic dough.

The procedure for the conventional method or ***cake method*** of mixing is described in figure 14.3. The conventional method of mixing should be used in all cake recipes unless the quick mix method is specifically recommended. The procedure for the quick method of mixing is described in figure 14.4. The flour to liquid ratio in cakes should be two to one.

Beating

Beating refers to the process of introducing air into a mixture or making it smooth by rapidly stirring the mixture with a spoon, beater, or whip.

Conventional Cake Method

1. Cream fat, add sugar gradually, and cream until fluffy.
2. Add eggs and beat well until the mixture is well blended. If more than one egg is to be added, add the first egg and beat well, then add the other egg and beat well. If they are added all at once, it disturbs the emulsifiers (shortenings) and causes a course texture in the final product.
3. Alternately add the sifted dry ingredients and the liquid ingredients beginning with the dry ingredients. Beat well after the addition of each.
4. Pour the batter into a greased pan and bake at 350°F to 375°F.

Figure 14.3

Quick Cake Method

1. Combine the sifted dry ingredients, fat, and part of the liquid and beat at a high speed for two minutes.
2. Add eggs and the remaining liquid and beat for an additional two minutes.
3. Pour into a greased pan and bake.

Figure 14.4

CUTTING

To conserve the maximum nutrients, vegetables should be cut in the largest pieces possible. Leaving as much skin in tact as possible also retains nutrients. Three ways to cut food include dicing, chopping, and slicing.

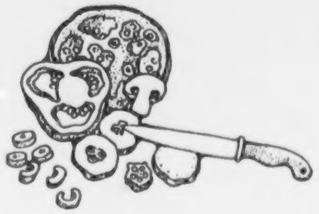
Dicing is a method of cutting food into cubes. ***Chopping*** refers to the process of cutting food with a sharp knife using an up-and-down motion resulting in small pieces of the food, either fine or coarse. ***Slicing*** refers to cutting the food either across or at an angle.

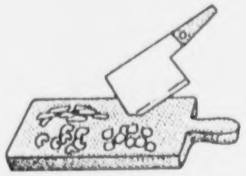
Cutting vegetables in small pieces shortens cooking time but exposes more surfaces to the cooking solution. Therefore, more nutrients can dissolve in the solution than if vegetables were cut in larger pieces.

The processes of canning, freezing, and dehydration also involve forms of manipulation that can affect the quality of the final food product. All fresh or raw foods are perishable. Processing slows deterioration so that the food can be eaten at a later date. Foods also are processed to improve flavor and digestibility, to kill harmful organisms and bacteria, and to provide convenience. Some processing techniques enhance the nutritional value of foods while others may decrease the nutritional value. For more information regarding canning, freezing, and dehydration of food products and their effects on food quality, refer to Chapter Thirteen.

Marketing (the process of moving food and food products from the producer to the consumer) has played a significant role in the variety of forms of products available today. The number of raw food products produced has not increased significantly over the last fifty years, but the variety of products available for the consumer to purchase has increased dramatically. Competition and marketing has encouraged food manufacturers to be creative and innovative which has led to the offering of products cut and prepared in numerous ways.

THE COOKING PROCESS





Food is cooked by the application of heat. Heat must be properly controlled to avoid excessive nutrient loss, shrinkage, overcoagulation (curdling) of protein, drying, and toughening. Foods are cooked to make them more digestible and appetizing. However, some fruits and vegetables eaten raw provide the most nutritional value. Foods are cooked to enhance flavor and digestibility; to improve appearance, color, and texture; to destroy harmful organisms and bacteria; and to provide variety.

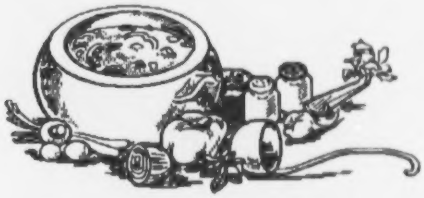
Cooking is a chemical process that converts foods into a more digestible form. Heat applied to raw starch converts it to a softer, gelatinized product that is easier for the body to digest and convert into energy. Protein foods such as meat and poultry are tenderized by the cooking process. This makes them more palatable and digestible. Fish is cooked to develop flavor, appearance, and aroma. Cooking does not make fish more tender but coagulates the protein or flesh, changing it from a gray color to a white, flaky product. The cooking process converts the starches in products such as noodles and breads into dextrins and simple sugars that are more easily digested.

The appearance, texture, and color of cooked foods is an important factor. Fried foods are evaluated first by their texture and then by their color. An even, golden brown color represents a satisfactorily prepared product whether it is chicken, fish, or a fried pie. A chemical reaction during the frying process causes a browning effect on the surface of the product and results in a crispy, textured crust.

The batter or cover that surrounds the food product is dehydrated during the frying process. As the moisture evaporates, the crust becomes crisp. Some of the moisture is replaced with the fat. The fat tenderizes the crust and moistens it similar to the way butter moistens toast.

Preserving food color is an important factor in the cooking process. The bright color of English peas and the red color of beets makes them more appealing to the eye. When these foods and others are exposed to heat, the color is dulled. The longer food is exposed to heat, the greater the color loss. This explains the color difference in frozen sweet peas and canned sweet peas. The frozen peas are only exposed to heat and liquid for a short period of time while the canned peas are exposed to high heat for several minutes and are stored in liquid.

The size of food pieces also is important to appearance. Pieces of potatoes and meat in soups, stews, and casseroles should be large enough to be recognizable, small enough to be bite sized, but large enough to retain the maximum amount of nutrients possible.



Nutrient loss cannot be stopped completely. It will occur to cooked foods no matter how careful the cooking procedures. Some nutrients dissolve into the water or solutions in which foods are soaked, cleaned, or cooked. These nutrients are called water-soluble. This occurs primarily with C and B vitamins and minerals. When food is cooked in a solution, the heat makes the cell membranes in the food become more permeable. This allows the water-soluble nutrients to easily pass through the membranes and into the cooking solution. Cooking solutions contain much of the food's nutrients. In order to receive the lost nutrients' benefits, people must consume the liquid as well.

Maximum nutrient retention can only be achieved if foods are cooked correctly. Overcooking or incorrect cooking results in the loss of valuable minerals and vitamins. There is a tendency to overcook certain foods such as vegetables or carbohydrates and meats or proteins. Cooking the foods in too much liquid also results in nutrient loss. Overcooking vegetables results in nutrient loss, color loss, mushiness, and flavor loss or undesirable flavor. Overcooking meats results in shrinkage and drying which makes the food unpalatable. To retain the maximum nutrients possible, vegetables should be cooked in minimum liquid for a minimum amount of time at minimum cooking temperatures, and the pieces should be as large as is practical. Figure 14.5 identifies suggestions for retaining water-soluble nutrients in foods.

Suggestions for Retaining Water-soluble Nutrients

- ✓ Avoid soaking foods.
- ✓ If soaking is necessary, use the same liquid when cooking the food.
- ✓ Do not discard juices from the food. About one-third of the nutrients of canned food is in the juices.
- ✓ Use juices for reheating foods or to make soups, stocks, sauces, and gravies.
- ✓ Use as little water as possible by using cooking methods that require less water.
- ✓ Reduce cooking times when appropriate.
- ✓ Cook vegetables only until they are tender and crisp.
- ✓ Cook with a covered utensil to reduce cooking time.

Figure 14.5

Heat Transfer

Heat is transferred from the source to the food in basically three ways: conduction, convection, and radiation. The transfer of heat requires that there be a difference of temperature between the heat source and the item to be heated. In cooking, the item to be heated is the food. Heat will flow to the item with the lower temperature.

Conduction is a process in which heat flows through solid matter by molecular transfer. Conduction is a direct transfer of heat. All matter contains molecules that are constantly in motion. The hotter the molecules become, the faster they move. The faster the molecules move, the more heat they generate. Different materials conduct heat at different rates. Some are better conductors of heat than others. Copper-clad stainless steel cooking utensils are very efficient heat conductors. Conduction is the heat transfer method used in conventional ovens.

When meat is roasted, heat currents flow toward the center of the meat. Once the cooking process is completed, the meat should be taken out of the oven and allowed to set for fifteen or twenty minutes before being cut. The internal juices will continue to circulate heat after being taken out of the oven. Allowing the meat to set for a few minutes allows the juices to continue the heating process and stop flowing naturally on their own. Slicing the meat too soon stops the natural flow of juices and causes the meat to lose color and natural juice and becomes dry.

Heat is transferred in the ***convection*** method when hot air flows around and over the food. Convection, like conduction, is a direct transfer of heat. A convection oven has a fan that forces the air to circulate inside the oven, therefore decreasing the amount of cooking time. Another example of heat transfer through the convection method is cooking in hot fat. Hot fat circulates around the food being cooked in a deep-fat fryer causing the food to cook more quickly than by other methods. Convection ovens are found in most restaurant and institutional kitchens and are becoming popular home appliances.

Unlike conduction and convection, radiation is not a direct transfer of heat. ***Radiation*** heats foods through the emission of invisible, infrared rays. The rays pass through the air and heat the surface of the food. The heat is absorbed and the internal heat is transferred by conduction. Microwave ovens heat food by this method. Nonionizing rays, or microwaves, are not dangerous. The other type, known as ionizing rays, cause chemical changes which have been linked to certain forms of cancer. Microwave ovens are safe and efficient appliances.

Cooking Methods

The basic two cooking methods are dry and moist. Figure 14.6 identifies examples of different types of dry and moist cooking methods. The method selected depends upon the type of food product to be cooked. For more information regarding cooking methods, refer to Chapter Sixteen.

Dry-heat Cooking
- baking
- broiling
- grilling
- microwave
- roasting

Moist-heat Cooking
- boiling
- braising
- steaming
- stewing

Figure 14.6

Summary

- Success in achieving a quality product not only involves the quality and proportion of the ingredients but also the method in which they are combined.
- Gluten is a tough, sticky substance developed from wheat flour that is formed by mixing the flour with a liquid and kneading or stirring.
- Mechanical mixing involves a mechanical device such as a hand-held mixer, table mixer, bench model mixer, floor model mixer, or blender that has an agitator that moves in a circular motion to distribute ingredients of a product evenly.
- To cook foods properly, heat must be controlled to avoid excessive nutrient loss, meat shrinkage, overcoagulation of protein, drying, and toughening.
- Maximum nutrient retention can only be achieved if foods are cooked correctly.
- Heat is transferred from the source to the food in basically three ways: conduction, convection, and radiation.

Vocabulary

agitators
batter method
beating
bench model mixer
biscuit method
blenders
cake method
chopping
conduction
convection
dicing
dough hook
flat beater
floor model mixer
food processors
gluten
hand-held mixer
hand mixing
kneading
manipulation
mechanical mixing
mixing
muffin method
pastry blade
pastry method
radiation
slicing
sponge-dough method
straight-dough method
sweet yeast breads
table model mixer
wire whip

Review

1. What is gluten and how is it formed?
2. How do the straight-dough, sponge-dough, and batter method of mixing differ?
3. What are the four types of mechanical mixers and how do they differ?
4. What are some characteristics of sweet yeast breads?
5. How should vegetables be cut to retain the maximum possible nutrients?
6. In what ways does processing affect the quality of the final food product?
7. Why are foods cooked?
8. Explain the conduction method of heat transfer.
9. How do the heat transfer methods of radiation and convection differ?
10. What are the two basic cooking methods?
11. How do the processing methods of canning, freezing, and dehydration affect the quality of the final food product?
12. List five suggestions for retaining water-soluble nutrients when cooking foods.

Critical Thinking

Make muffins following the muffin method procedure and a recipe. Make the same recipe again using a mechanical mixing device. Compare the two products visually and by taste. What differences are there? similarities? What factors contribute to the similarities and differences of the two products?

15

Cooking Utensils

ESSENTIAL ELEMENT

- ❑ Determine the effect of various cooking utensils on food products.(j3D)

OBJECTIVES

- ❑ Compare the characteristics of the various materials used for cooking utensils.
- ❑ Identify basic meal preparation utensils and their uses.

Cooking and baking utensils are used for food preparation in food operations and in the home. These utensils also are known as bakeware and cookware or pots and pans. ***Utensils*** are small hand tools that are used to stir, cut, mix, serve, and hold food and beverages during preparation. ***Cooking utensils*** include the different types of pots and pans used to cook food, such as griddles and skillets. ***Baking utensils*** include loaf pans, casserole dishes, cookie sheets, muffin pans, pie plates, cake pans, and roasters.

Some food and food preparations require a special type of utensil. For instance, some foods are marinated in pans for several hours before they are cooked. A ***marinade*** is a spiced solution in which meat or fish is placed before cooking. It usually contains an acidic liquid such as wine, vinegar, or lemon juice as well as spices and oil. Metal pans can be discolored by the acid in the marinade; therefore, metal pans should be avoided. Glass and plastic containers are not affected by acidic solutions.

CHARACTERISTICS OF MATERIALS

The quality of bakeware and cookware is measured by their ability to conduct heat evenly, clean easily, and remain durable. The finish on the outside of the bakeware affects how the final baked product will look. A shiny finish reflects heat while a dark finish absorbs heat. A product baked in bakeware with a shiny finish has a light-colored crust while one baked in bakeware with a dull or dark finish has a darker, crispier crust. Figure 15.1 describes factors to consider when selecting bakeware.

Factors to Consider When Selecting Bakeware

- Flat surfaces provide the best contact with the heat source.
- Knobs and handles should be heat resistant.
- Thick metals are less likely to warp and dent than thin metals.

Figure 15.1

Good quality cooking utensils distribute heat evenly and allow food to cook evenly. If hot spots develop, the utensil is not considered to be of good quality. ***Hot spots*** occur when the utensil becomes hotter in one area than in another, making the food heat unevenly. The heat may scorch the food. The type and thickness of metal from which a pot or pan is made affects uniform cooking.

Cast Iron

Cast iron is the traditional material used for cookware and bakeware. It is heavy, durable, heats slowly, yet holds and conducts heat very well. It has a textured surface that enables it to hold oil. The oil helps to keep food from sticking to the utensil. Iron can rust, retain certain food odors, and discolor some acidic foods. Cast iron must be seasoned to keep foods from sticking and to avoid rusting.

Seasoning a cast iron piece involves wiping it with oil and heating it in the oven. It should be washed by hand in hot detergent water, wiped dry with a clean towel, and dried completely in a warm oven. Cast iron should never be scoured because the process removes the oil needed for seasoning.

Aluminum

Prior to World War I, iron was the primary material used for making pots and pans. Advances in science and technology led to the development and use of other products for cookware and bakeware. ***Aluminum*** is very popular for both cookware and bakeware and is a good conductor of heat, spreading it quickly and evenly. Cast aluminum is heavier and is used for utensils such as skillets. Sheet aluminum is lighter in weight and is used for items such as cookie sheets. As with other cooking materials, the thicker the product, the more durable it is.

Aluminum is a good conductor of heat, but it should not be used for storing food or for cooking foods for a long time. High-acid foods may cause chemical reactions to occur. Food acids cause metals to become soluble. The longer acidic foods remain in contact with the metal, the more the metal dissolves. Some dissolving metals contaminate food and, therefore, should never be used to contain foods. These metals include copper, galvanized metal, the metal base of chipped enameled pans, brass, and cadmium.

Untreated aluminum surfaces stain or darken when they come in contact with certain foods. The same problem can occur when an aluminum utensil is washed in a dishwasher. When aluminum is used with alkaline foods or those with pH levels above 7, such as milk and other dairy products, it can discolor and pit. Anodizing aluminum refers to the process of putting a protective, often colored, oxide (light metal) film on the utensil surface. Anodized surfaces provide better wear and are better conductors of heat than polished, shiny surfaces.

There has been some concern in recent years about using aluminum utensils due to aluminum's role in Alzheimer's disease. Alzheimer's disease is a progressive, degenerative disease that affects the brain cells. The disease progresses through various stages of mental loss and eventually results in death.

According to the *Tufts University Diet and Nutrition Letter*, Vol. 8, #8, October 1990, scientist's have found large amounts of aluminum accumulations in the brains of individuals with Alzheimer's disease. The aluminum accumulations appear to be a result of Alzheimer's disease and not a cause of it. The use of aluminum utensils has not been proven to play a role in the development of Alzheimer's disease.

Copper

Copper is a very good conductor of heat, but it can be expensive. Pure copper cannot be used alone for cooking because it reacts with certain foods, causing poisonous compounds. It is often applied to the bottoms of other types of cookware, such as copper-clad stainless steel pots and pans. Copper discolors and must be polished often to remove tarnish. Copper cookware items are usually lined with a thin layer of chrome, stainless steel, or tin. Great care should be taken when cleaning this lining. If the copper is exposed, the utensil may become dangerous to use.

Clear Glass

Utensils made of glass do not react to food colors or flavors. Glass absorbs heat quickly and holds it well. Glass is very sensitive to sudden changes in temperature, however, and can break easily. Glass is not a good conductor of heat (able to transfer hot to cold), and it cracks, breaks, and chips easily. Glass is not used in commercial food preparation because of the potential for breakage.

Enamelware

Enamelware is made by a process that fuses or melts several layers of a glass-like material on an iron base. It is very resistant to acidic foods because of the layers of baked-on enamel. Enamelware absorbs and holds heat well, does not discolor food, does not affect the taste of food, is easy to clean (unless food is allowed to burn), and is available in a variety of colors. Metal utensils, such as spoons, can damage the surface of the piece. Enamelware can chip when dropped or exposed to sudden temperature changes.

Glass-ceramic

Glass-ceramic or ***opaque glass*** bakeware is a very durable product that can withstand high temperatures without breaking. It can be taken from freezer to oven to dishwasher without difficulty. It is a slow conductor of heat and may have hot spots. Glass-ceramic bakeware performs best in low to moderate temperatures.

Stainless Steel

Stainless steel is an alloy or mixture of nickel, steel, and chromium. It is used for cookware and bakeware; however, stainless steel is not the best material for bakeware such as cake pans and cookie sheets. Stainless steel is very durable, stain resistant, easy to clean, and does not discolor foods. It is a poor conductor of heat and tends to scorch foods easily when used alone for bakeware and cookware. It is usually combined or clad with other products, such as copper and aluminum, to increase its heat distribution capabilities. It is a slow conductor of heat, but once heated, stainless does hold heat well. Stainless steel is excellent for storing foods because it does not react chemically with foods as other metals do. Stainless can be expensive and shows water spots easily.

Plastic and Other Materials Safe for Use in the Microwave Oven

Plastic utensils have gained popularity and quality with the increased use of microwave ovens. Plastic utensils are resistant to stain, easy to clean, and safe in the dishwasher and microwave ovens. Many also can be used in the freezer. Depending on the plastic, some utensils can be used in the oven while others cannot withstand temperatures above 400°F.

Utensils other than plastic also can be used in the microwave oven. If a person is not sure of the safety of a particular piece in the micro-

Safe for Microwave Use	Unsafe for Microwave Use
✔ glass ✔ paper ✔ earthenware ✔ dishwasher-safe plastics ✔ microwave oven cookware ✔ china that does not have a metal trim ✔ round utensils instead of square ✔ covers – plastic film – paper towels – paper plates – waxed paper ✔ porous materials, such as paper, should be used with dry-surfaced foods	✗ metal ✗ aluminum foil ✗ paper goods made from recycled paper (some paper towels are made from recycled paper)

Table 15.1

wave oven, a simple experiment can be conducted. A person can pour approximately one-half cup of water in the dish, place it in the microwave oven, and cook on the highest temperature for one minute. If the water is warm and the dish is still cool, the dish is safe to use in the microwave oven. If the dish is hot and the water is cool, the dish is not recommended for use in a microwave oven.

Metal utensils reflect the microwaves (waves that generate heat by agitating molecules inside food) away from the food in the container, hence slowing the cooking process. Using metal utensils in a microwave oven can cause a sparking or lightening effect. This effect is called ***arcing***. Arcing can permanently damage the microwave oven. Table 15.1 identifies items that are safe or unsafe for use in the microwave oven.

Nonstick Finishes

Nonstick finishes on preparation, cooking, and baking utensils provide surfaces that help keep food from sticking to the utensil. The substance used in the finish is fluorocarbon resin. The nonstick finish also makes it easier to clean the utensil.

Plastic or rubber utensils should be used with the nonstick finishes because the finish can be damaged by metal utensils or steel wool. If scratches occur, the utensil is still safe to use. However, there has been some controversy as to the safety of using utensils with scratched finishes. Some people have been concerned with the possibility of food being contaminated with flakes of the fluorocarbon resin. The *Tufts University Diet and Nutrition Letter*, Vol. 8, #8, October 1990, issue reported that studies have shown that even if flakes of the fluorocarbon resin were swallowed, the body could not digest them and they would pass through the body in their original state.

BASIC UTENSILS

Figure 15.2 represents basic meal preparation utensils needed for food preparation. Some people prefer to use electrical appliances that can perform tasks, such as toasters, electric skillets, blenders, food processors, mixers, electric knives, and waffle irons, rather than using basic utensils.

Basic Utensils

- graduated measuring cups for dry ingredients
- measuring cups for liquid ingredients
- graduated measuring spoon set
- two to three sizes of mixing bowls
- skillets or frying pans, at least one with a lid
- set of saucepans
- shallow roasting pan
- two layer cake pans
- loaf pan
- twelve section muffin pan or two six section muffin pans
- cookie sheet/baking sheet
- one or two pie plates
- casserole dishes preferably with lids
- vegetable peeler
- grater/shredder
- kitchen shears
- tongs
- long handled fork, solid spoon, and slotted spoon
- set of sharp knives
- knife sharpener
- cutting board
- rolling pin
- pancake/hamburger turner
- metal spatula
- rubber spatula
- colander
- graduated sizes of refrigerator/freezer storage containers with lids

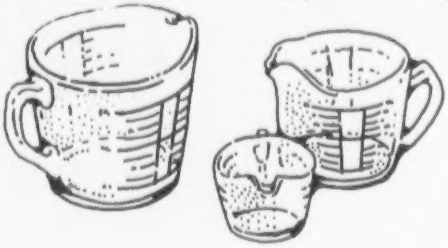
Figure 15.2

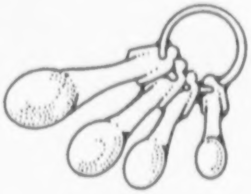
Quality in food preparation cannot be achieved unless ingredients are carefully measured. Measuring cups and spoons are used for measuring both liquid and dry ingredients. A typical set of U.S. Standard graduated ***dry measuring cups*** include 1/4 cup, 1/3 cup, 1/2 cup, and 1 cup. ***Liquid measuring cups*** have a pouring spout and are used to measure cups and ounces. Horizontal lines on the outside of the measuring cups indicate the increments of measurements. Liquid cups are made of glass or clear plastic. ***Measuring spoons*** are used to measure small amounts of both liquid and dry ingredients. A standard set of measuring spoons includes 1/4 teaspoon, 1/2 teaspoon, 1 teaspoon, and 1 tablespoon. Measuring spoons are usually made of metal or plastic.

Mixing bowls can be made of glass, aluminum, stainless steel, or plastic. Glass bowls can break easily and should be handled carefully. Aluminum bowls tend to darken egg white mixtures. Stainless steel bowls are used by food service operations because of their durability.

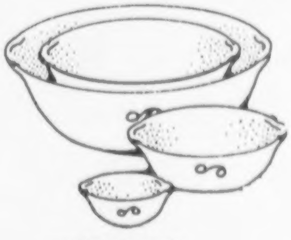
Skillets or frying pans are used for cooking food in a small amount of fat. They can be used for pan-frying or sautéing (cooking in a small amount of fat), browning, or making sauces and liquids that require volume reduction (removal of air from a liquid). They have sloped sides to make access to the food easier when a spatula is used. They are available in many sizes and from a variety of metals including stainless steel, cast iron, and copper-clad stainless steel.

liquid measuring cups





measuring spoons



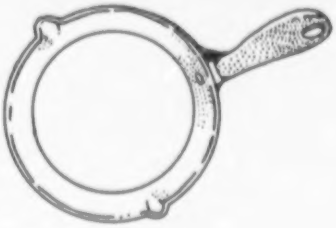
mixing bowls

Saucepans are deeper than skillets and have straight or slanted sides, lids, and long handles. They are available in many sizes and made from a variety of metals including cast iron, stainless steel, and copper-clad stainless steel. Standard sizes for home use are one, two, and three quart capacities.

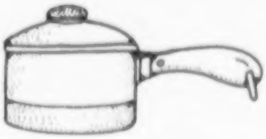
Shallow roasting pans are large rectangular pans used for roasting meat, poultry, and fish. ***Cake pans*** may be round or square with two-inch sides. They are used for making layer cakes and coffee cakes. ***Loaf pans*** are used for baking bread or meatloaf. ***Muffin pans*** are used for baking muffins and rolls. They are available with six or twelve sections and in standard or small sizes. ***Baking sheets*** are flat metal utensils that have at least one raised edge. Some may have four raised edges. They are used for baking cookies, biscuits, and various sweet rolls. ***Pie pans*** are used not only for pies but for other dishes as well. Materials used include glass, aluminum, aluminum foil, and glass ceramic. Standard sizes include the eight-inch and the nine-inch wide pans.

Casserole dishes are available in a variety of sizes, shapes, colors, designs, and materials. Some are available with lids while others are not. Glass ceramic, glass, earthenware, and baked-on enamel materials are used most often to make casserole dishes.

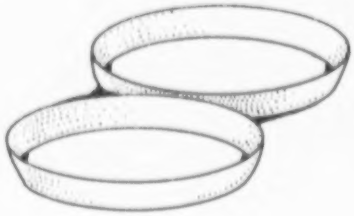
A ***vegetable peeler*** is used for peeling and for slicing thin strips of fruits and vegetables. It also may be used for removing the cores from fruits and vegetables. A ***grater*** is used to grate, shred, slice, and serrate foods such as carrots, cabbage, and cheese. Vegetable peelers and graters have blades made from stainless steel. They may be either square or flat with different shapes and sizes of slots or grids. ***Kitchen shears*** are used for snipping fresh herbs, cutting garnishes, and trimming pastries. They may be used for many other kitchen tasks. ***Tongs*** are used to grasp a food item to lift and turn during the cooking process. Tongs are made of metal, and the handles are covered with plastic or rubber.



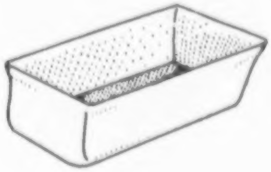
skillet



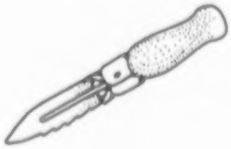
saucepan



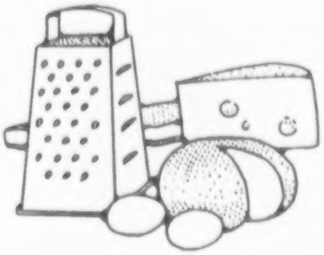
cake pan



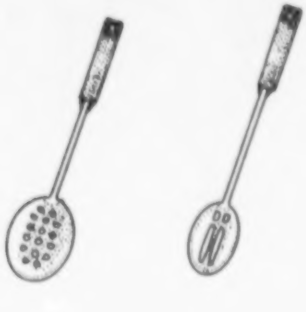
loaf pan



vegetable peeler

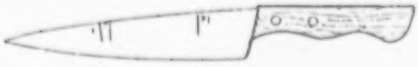


grater

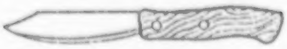


Long-handled forks, solid spoons, and slotted spoons have extra long, heat-resistant handles. The long handles enable hands to stay away from hot foods, spattering fat, and steam.

Knives are very important tools in the kitchen. A good set of sharp knives is necessary for cutting, slicing, and dicing foods safely and effectively. Most knives are made of stainless steel. Stainless steel is very durable and does not rust, and the blade stays sharp. Some blades are made of high carbon steel which is very hard and durable. One disadvantage of high carbon steel is that it stains easily and must be scoured after each use.

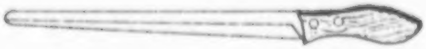


French knife

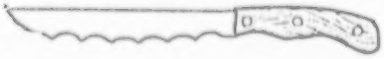


paring knife

The two major parts of a knife include the blade (the sharp portion) and the haft or handle. The tang, or the metal extension of the blade, is the portion that extends into the handle or haft. The tang should run the entire length of the knife and be attached with at least two rivets. Rivets are metal bolts or pins used to hold the handle and the blade portions together. Handles of knives are made of wood or plastic. Knives should be washed by hand, rinsed, and dried as soon as possible. Knives should not be washed in a dishwasher. The knives do not keep a sharp edge if washed in the dishwasher.



slicer knife



bread knife

A ***French knife*** has a wide, curved blade approximately ten to twelve inches long that tapers into a point at the end and is used for chopping, mincing, dicing, and slicing foods. A ***paring knife*** has a blade that is two to three inches long. It is used for trimming or cutting away skins from fruits and vegetables. A ***slicer knife*** has a long, narrow blade that is ten to sixteen inches in length. It is used to slice vegetables and meats or to cut cakes and sandwiches. The blades of ***bread knives*** have serrated (sawlike) edges that allow them to cut easily through bread crusts.

Knives are easier and safer to use when they are kept sharp. A ***knife sharpener*** or ***sharpening steel*** is used to file the edges of knives to make them sharp. These are made of steel that is harder than the steel used to make knife blades. The steel of the knife sharpener may be flat, cylindrical, or oval, and it may have a steel shaft.

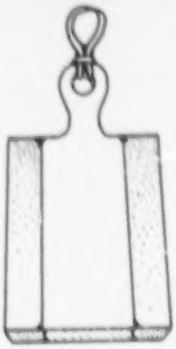
Cutting boards are surfaces on which foods can be cut. Hard rubber and plastic are recommended. They are easier to clean and are more sanitary than wood.

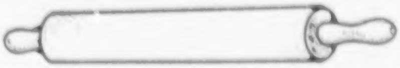
Rolling pins are made of smooth hardwoods and are used to roll out dough or crush bread crumbs.

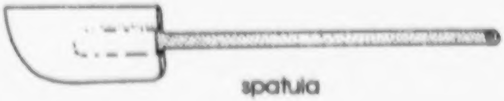
Spatulas have flat, thin, flexible blades with dull, rounded edges. They are used to turn meat, pancakes, potatoes, and other foods while browning. An offset or bent handle keeps the hand away from the hot cooking surface. The blade may be solid or perforated. The blades are made of plastic, rubber, or stainless steel.

Colanders are perforated metal or plastic bowls with a pedestal base and may or may not have handles for lifting. They are used to drain cooked foods such as pasta and to rinse salad greens and berries.

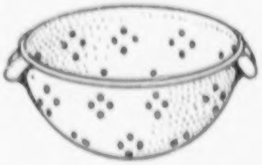
Storage containers are used for foods both before and after they are cooked. Containers used should have tight-fitting lids or be covered tightly with an appropriate wrap.


cutting board


rolling pin


spatula

colander



Summary

- Cooking utensils include the different types of pots and pans used to cook food.
- Baking utensils include loaf pans, casserole dishes, cookie sheets, muffin pans, pie plates, cake pans, and roasters.
- The quality of bakeware and cookware is measured by their ability to conduct heat evenly, clean easily, and remain durable.
- Cast iron is the traditional material used for cookware and bakeware.
- Aluminum is a good conductor of heat, but it should not be used for storing food or for cooking foods for a long time.
- Pure copper cannot be used alone for cooking because it reacts with certain foods, causing poisonous compounds.
- Enamelware is made by a process that fuses or melts several layers of a glass-like material on an iron base.
- Metal utensils reflect microwaves away from the food in the container, hence slowing the cooking process.
- Aluminum bowls tend to darken egg white mixtures.
- A good set of sharp knives is necessary for cutting, slicing, and dicing foods safely and effectively.
- Storage containers should have tight-fitting lids or be covered tightly with an appropriate wrap.

Vocabulary

aluminum
arcing
baking sheets
baking utensils
bread knives
cake pans
cast iron
colanders
cooking utensils
marinade
measuring spoons
muffin pans
nonstick finishes
opaque glass
paring knife
pie pans
rolling pins
saucepans

copper
cutting boards
dry measuring cups
enamelware
French knife
glass-ceramic
grater
hot spots
kitchen shears
knife sharpener
liquid measuring cups
loaf pans
seasoning
shallow roasting pans
sharpening steel
skillets
slicer knife
spatulas
stainless steel
storage containers
tongs
utensils
vegetable peeler

Review

1. How does the outside finish of a utensil affect the appearance of the final baked product?
2. What is seasoning?
3. Which metals can be adversely affected by acidic solutions?
4. Why is copper used with other metals in cooking utensils?
5. How does enamelware react to acidic foods? Why?
6. What types of utensils should not be used in the microwave oven?
7. What type of material is used for making liquid measuring cups?
8. How is the structure of dry measuring cups different from that of liquid measuring cups?
9. Why is it important to have good quality, sharp knives?
10. What are the advantages and disadvantages of nonstick finishes?
11. How do aluminum mixing bowls affect egg white mixtures?

Critical Thinking

Visit a grocery store, department store, discount store, and gourmet store that sell cooking utensils. Compare the prices of different materials and utensils. Which materials are more expensive? Compare the weight and quality of the different materials. What information is given about the utensil's use? material's use? Can the material be used in a regular oven or a microwave oven or both? Which material do you prefer and why?

16

Effects of Temperature on Food Products

ESSENTIAL ELEMENT

- ☐ Determine the effect of various temperatures on food products.(j3E)

OBJECTIVES

- ☐ Compare the various methods of heating food products.
- ☐ Evaluate the effects of freezing, refrigeration, and dry storage on food products.
- ☐ Analyze the effects of altitude levels on food cookery.

The type of cooking method selected and length of time needed to cook any food depends on many factors. The composition of the food product—including the type, size, shape, and weight—must all be considered during the cooking process. The cooking method selected also adds variety and appetite appeal to foods. Many cooked foods are more appealing to the appetite than the raw product.

Cooking destroys harmful bacteria, organisms, and enzymes found in food items. Temperatures of 185°F for ten minutes kills nonspore organisms and bacteria. When larger pieces of food are cooked, such as roasts, the heat does not penetrate as quickly. This makes it necessary to lengthen the cooking time to kill the harmful organisms. Acidic foods such as tomatoes, peaches, and apples do not require temperatures as high as low-acidic foods. The high acid content in the food naturally inhibits the growth of harmful bacteria. Temperatures of 160°F are sufficient for cooking high-acidic foods to kill harmful organisms.

Storage is also an important part of food preparation. Proper storage protects nutrients from light, heat, air, and moisture. The different types of storage include refrigerator storage, freezer storage, and dry storage.

METHODS OF HEATING FOOD PRODUCTS

There are various methods for cooking foods. Each method has its advantages and disadvantages. Pressure steamers and pressure cookers use moist heat and high cooking temperatures but cook very quickly, thus balancing temperature with time. Steaming, stir-frying, pressure cooking, boiling, microwave cooking, broiling, grilling, and convection oven cooking methods retain a percentage of a food's texture, flavor, and color. If performed correctly, these methods allow for the retention of many of a food's nutrients.

The amount of time needed to cook items depends on the temperature used, characteristics of the food item, amount of food, temperature of the food before cooking, and the speed of heat transfer characteristics of the chosen cooking method. Steam is a better conductor of heat than air. This is why it takes longer to bake a vegetable than to steam a vegetable. Convection ovens heat more thoroughly than conventional ovens because the forced air in the oven transfers heat rapidly. Cooking with convection ovens is faster than cooking with conventional ovens.

Special care must be taken when cooking vegetables and fruits. Heat, baking soda, and alkalies (such as egg whites) cause vegetables and fruits to soften. These elements break down fiber substances that provide the structure and firmness of these foods. Alkalies cause nutrient loss and mushy textures when added to foods being cooked. Sugar helps keep fiber firm. Fruits cooked with sugar are more likely to stay firm and keep their shape.

Two cooking methods used in both commercial and home kitchens include dry-heat cooking methods and moist-heat cooking methods. ***Dry-heat cooking methods*** are cooking methods that surround food with hot, dry air. They include baking, roasting, and broiling. ***Moist-heat cooking methods*** are methods that use liquid to cook foods. Boiling, steaming, poaching, simmering, and braising are examples of cooking with moist heat. As much as possible, care should be taken during moist-heat cooking to prevent nutrient loss. Steam is an excellent method of moist-heat cooking because nutrient loss is minimal; foods maintain their shape and color and are cooked rapidly.

Nutrients, flavor, and color can be lost in cooking. These can be preserved as much as possible by selecting appropriate cooking methods. To prevent nutrient loss and poor appearance, vegetables and fruits should be cooked carefully and for as little time as possible. Steaming is a good cooking method for fruits and vegetables because it helps preserve natural qualities and nutrients better than most other cooking methods.

Steaming

Steaming is a cooking process in which food is cooked using steam as the conveyor of heat. The food is placed in a pan that is held above boiling water. Steaming takes more time than boiling but allows the retention of more nutrients than boiling as long as the food is not overcooked. Because it is not in water, the product's original shape is retained.

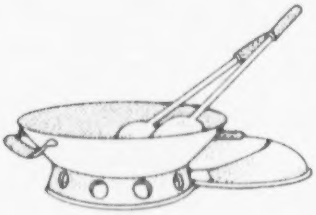
The two types of steam cooking include normal and pressure generated steam cooking. In the normal method of steaming the water does not touch the food and the container is not airtight. It is an excellent method for cooking vegetables because they retain their flavor, color, and nutritive value quite well. Steaming is fast but causes moisture to condense on the vegetables. Nutrients in the vegetables may dissolve into the moisture and become lost when the moisture drips off the vegetables. Steaming is used primarily for vegetables. Some meats are steamed over juices or broths that allow the meat to cook slowly, adding flavor from the juice or broth and leaving the meat tender and juicy. Meats and poultry are typically not cooked by the pressure steam method because the steam tends to overcook the meat and makes it less flavorful.

Pressure generated steam cooking or ***pressure cooking*** is a method in which steam is generated and contained in an airtight container that allows the steam and the internal temperature of the container to build up and cook the food. It is a fast method of cooking and is used often for cooking less tender cuts of meat, chicken, and vegetables. The high temperature and pressure result in a greater loss of nutrients and can change the color of green vegetables to a brownish-green color.

Stir-frying

Stir-frying is a method of cooking food quickly in a small amount of oil. It is a form of Chinese cooking similar to sautéing. The food is cooked quickly and can give vegetables a unique flavor. Stir-fried foods are often seasoned with soy sauce.

The food should be cut into small pieces, coated lightly with oil, and cooked in the wok with a small amount of water. A ***wok*** is a round metal pan that stands over heat. Food should be cooked until tender but not overdone.



Boiling

Boiling is a fast method of cooking using water or other liquids at high temperatures. This method is common for cooking vegetables. The food is placed directly in the water or liquid and remains there until the cooking process is complete.

Boiling breaks up the structure of vegetables and causes nutrients to dissolve into the water or cooking solution. To maximize the retention of nutrients, taste, color, and texture, food should be boiled in a covered saucepan with one-fourth cup of water or liquid per serving. To minimize cooking time and the length of exposure to high temperatures, the water or liquid should be brought to a boil before the food is added. After the food is added, the liquid should be allowed to come to a second boil. The heat source should then be turned down to facilitate a gentle boil rather than a rapid boil.

Many cuts of meat and poultry are boiled to prepare them for being served cold. The meat and poultry is covered in water and simmered with appropriate spices and seasonings. The meat or poultry can later be cut in slices or cubes for sandwiches, salads, or casseroles.

Braising

Braising is cooking food in its own juices or with a small amount of added liquid. Braising is also known as fricasseeing. Braising requires use of low heat but a long cooking time. Again, nutrients could be lost because of the length of cooking time; however, the use of low heat helps to minimize the nutrient losses.

Braising is a moist-heat method of cooking, making it suitable for less tender cuts of meat. Braising is used primarily for chicken and veal. Braising some veal cuts helps to soften connective tissue. It is also used for the flank in the beef hindquarter. Braising is recommended for the following types of meat:

- individual portions of meat such as pork chops and Swiss steak
- chunks, cubes, or ground meat
- large cuts of meat such as pot roast
- older chickens known as stewers
- beef brisket, chuck, plate, and shank
- picnic ham
- lamb shanks, necks, and shoulder
- variety meats

Broiling

Broiling is cooking with direct heat from hot coals, a gas flame, or an electric element. The food is placed three to five inches below the burner. Broiling some veal cuts helps to soften connective tissue. Some nutrients as well as fat will drip away from meat that is broiled. It can be easy to overcook meats that are broiled if one does not watch the cooking process closely. Broiling is good for high water content fruits and vegetables as well as tender and juicy cuts of meat.

Tomatoes are probably the most popular broiled vegetable. Thickly sliced or halved tomatoes may be topped with buttered crumbs and broiled until brown. Some scalloped vegetables (vegetables cooked in a cream sauce) may be broiled for a short time to brown the tops.

Broiling meats with dry heat causes the juices to drip from the meat. These juices may contain nutrients that are lost. With the dry heat method there is also a danger of overcooking. Animal proteins are sensitive to heat. When they are broiled or cooked on outdoor grills, they can overcook quickly.

Broiling is a good way to cook fish. Fat fish (mullet, salmon, tuna, trout) broil better than lean fish (halibut) because they do not dry as easily as lean fish. Both types of fish should be oiled before they are broiled to maintain moistness. Oil should be used instead of butter because butter will burn.

Grilling

Grilling is done by placing food on a solid heating surface, on a surface with grids, or in a hot pan over heat. Grilling is also known as panbroiling or panfrying. Food items typically grilled include ground meat, sausage, steaks, ham, thin pork chops, and bacon. Cooking foods on an outside grill with heat from charcoal or gas also is called grilling.

MEAT
the
CHEF

Smoked flavors such as mesquite, hickory, oak, or cherry can be added to foods that are grilled. Wet wood chips of the chosen flavor are placed on the charcoal grills. A gas grill cooks the food in similar manner to that of the charcoal. The burning gas heats ceramic reflectors or porous rocks that radiate the heat to the food.

Microwave Cooking

Microwaves are short, high frequency waves of energy that are created by a magnetron which converts electricity into electromagnetic energy. Microwave cooking is done in a microwave oven that cooks with microwave energy. The microwaves generate heat by agitating the molecules inside the food. The majority of the heating of the food product occurs in the outer two centimeters of the product. The heat travels to the center of the food through a process called conduction.

The main advantage of cooking foods in a microwave oven is the amount of time that can be saved. Most foods can be cooked two to ten times faster in a microwave oven than in a conventional oven. It is a good method for cooking vegetables. The destruction of vitamin A (retinol) is greater in microwave cooking than in boiling or steaming.

Water is very reactive to microwaves and rapidly converts to steam. It is necessary to puncture the skin or membranes of foods to allow the steam to escape. Pockets of water in foods may become very hot and explode. Puncturing the skin or membranes helps to alleviate the potential of a steam explosion.

There is no set standard for cooking power in microwave ovens. An oven with more cooking power cooks food faster than one with less power. Each oven is different and adjustments in cooking time must be made accordingly.

Not all substances react to microwaves in the same way. Some microwaves are absorbed, some transferred, and some reflected. Foods that contain moisture and fat absorb the microwaves readily and become hot. Utensils used in the microwave must be able to transfer the microwaves rather than absorb or reflect them. Glass, paper, and some plastics do not absorb the microwaves, but transfer them. These materials are used for microwave cookware because they transfer the microwaves to the food. Metals reflect the microwaves and block them from the food. The use of metal utensils can also cause a static electrical charge that causes sparks. The sparks formed can cause a fire if paper or plastic products are also being used. Therefore, standard pots and pans cannot be used in the microwave. For a list of materials that are safe to use in the microwave, refer to Chapter Fifteen.

Fresh and frozen vegetables retain more nutrients when they are cooked in microwave ovens. The quality of vegetables cooked in the microwave depends upon the type of vegetable. Some vegetables retain more nutrients, color, flavor, and original texture than others. Spinach and broccoli are examples. As a whole, more nutrients and color are retained by vegetables cooked in the microwave oven than by those that are boiled; however, some vegetables may produce a more tough, fibrous texture as a result of microwave cooking.

Convection Oven Cooking

Convection ovens cook foods by using heated air and air circulation. A fan in the convection oven forces and circulates heated air within the oven producing faster cooking time at a lower temperature. Convection oven temperatures should be approximately 25°F to 50°F lower than the temperature needed in a conventional oven. A convection oven also provides a more uniformly cooked product than a conventional oven.

FOOD STORAGE

Storing foods properly is important for maintaining quality and nutrients. Types of food storage include freezing, refrigeration, and dry storage.

Freezing

Freezers are useful for long-term storage of many perishable foods. However, lengthy freezer storage increases opportunities for contamination and spoilage. Many frozen foods deteriorate rapidly.

Freezing has little if any effect on flavor, texture, color, and nutritional value. Most foods can be frozen successfully with the exception of a few food products including lettuce, raw cabbage, raw celery, mayonnaise, potato salad, gravies, sauces, puddings, custards, cream pie fillings and other creamed foods, hard cooked egg whites, and watermelon. Items that deteriorate in freezer storage include hamburger, fatty fish, turkey, and pork. Processed meats such as ham and luncheon meats should not be frozen. Doing so decreases the flavor and appearance.

For safe and efficient freezer operation, the following guidelines should be observed:

- Maintain an air temperature of 0°F or below.
- Use one or more easily visible thermometers to monitor freezer temperatures.
- Defrost freezers as often as recommended by the manufacturer.
- Store frozen foods promptly.
- Store frozen foods in moisture-proof materials or containers.
- Store frozen-food products in the cartons in which they were packaged. Repackage if carton is broken or space is not available for original cartons.
- Open the freezer only when necessary and remove as many items as possible at once.
- Remove from storage only the quantities of frozen food that can be used immediately.

Frozen food should be defrosted only by using one of the following four methods as recommended by the United States Department of Agriculture (USDA) and the Frozen Food Handling Code described in Chapter Thirteen.

- Defrost according to the manufacturer's instructions.
- Defrost in a refrigerator with a temperature not greater than 45°F.
- Defrost under drinkable running water at a temperature not greater than 70°F, and cook immediately.
- Defrost in a microwave oven or in conventional cooking equipment as long as the thawing and cooking process are continuous.
- Never defrost foods on the counter top at room temperature.

For more information on freezing and other storage methods, refer to Chapter Thirteen.

Refrigeration

Refrigeration is used for short-term holding of perishable food items. Refrigeration slows the growth of bacteria in foods but does not destroy bacteria already present in foods.

Meats, fish, and dairy products require the lowest refrigeration temperatures while fruits and vegetables need higher temperatures. Refrigerator storage temperatures should remain between 32°F and 40°F. The cold storage of food is important to keep bacteria from growing. Foods items with potential to leak should not be stored above other food items. These items must be stored on the lowest racks so the possibility of contaminating other food does not exist. For example, thawed meat in a pan of meat juices stored above other food in a cooler could contaminate the other food if the juice spills or leaks from its container. When placed on the lowest rack, the food would spill on the floor of the refrigerator, not on other foods.

For safe and efficient refrigerator operation, the following guidelines should be observed:

- Do not overfill refrigerators. Overfilling makes cleaning difficult and may prevent air circulation necessary for maintaining proper temperatures.
- Store all foods in clean, nonabsorbent, covered containers or in original packages.
- Allow space between containers to ensure air circulation.
- Avoid lining shelves. It interferes with air circulation.
- Avoid adding large amounts of warmer foods to the refrigerator at once. Divide large amounts of food into small containers and shallow pans to ensure thorough quick cooling. Stir periodically if necessary.
- Open a refrigerator only after identifying products needed, not before. Make as few trips to the refrigerator as possible.

Dry Storage

Dry storage areas should be well ventilated, well lighted, clean, and protected from pests and excessive moisture. Dry storage areas should be cool, dry, dark areas with temperatures from 50°F to 70°F. A temperature of 50°F increases the shelf life of many products. The ***shelf life*** refers to the length of time a product can be stored without serious change in quality. Storing dry goods in temperatures above 70°F increases the chance of spoilage. The likelihood of spoilage rises sharply as storage temperatures rise. A relative humidity of 50 to 60 percent is satisfactory for most foods in dry storage. Adequate ventilation is necessary to maintain the quality of foods in dry storage and to prevent insect infestation.

Cans, jars, and bottles that do not need refrigeration may be stored in dry storage. Packaged foods such as rice, seasonings, and grain products also may be placed in dry storage. A person should always reseal packages that have been opened or transfer contents to a container with a tight-fitting lid. Canned foods that have leaks, bulges, or uncommon odors should not be used.

To ensure safety and sanitation in a dry storage area, the following guidelines should be observed:

- Never store food directly on the floor.
- Never keep garbage where food is stored.
- Store heavy and bulky items on shelves or in bins closest to the floor.
- Keep the area swept and clean it regularly.

Table 16.1 shows how long specific foods may be kept in the refrigerator, freezer, or in dry storage. The time periods for refrigeration

Food Storage Guidelines

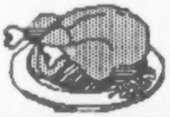
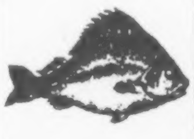
Food Product	Refrigeration		Freezing		Dry Storage	
	Temperature/ Procedure	Storage Life	Temperature/ Procedure	Storage Life	Temperature/ Procedure	Storage Life
Meat (frozen or unfrozen beef veal, or lamb) 	(unfrozen) 36°F or below Store as soon as possible. Wrap raw meat loosely.	2 or 3 days	(frozen) 0°F or below Store as soon as possible. Store in original wrapping. Wrap and seal in moisture-proof paper or containers.	up to 1 yr.	Not recommended	
Poultry (frozen or unfrozen) 	(unfrozen) 36°F or below Store as soon as possible. Wrap whole birds loosely.	3 days cooked pieces 2 days	(frozen) 0° F or below Store as soon as possible in original wrapping.	6 mo. to 1 yr.	Not recommended	
Seafood 	(fresh) 30°F to 34°F Store as soon as possible. Cover with crushed ice. Wrap to prevent from soaking up water.	up to 3 days fish not iced: 24 hr.	0°F or below Freeze in original wrapping.	3 to 4 mo.	Not recommended	

Table 16.1

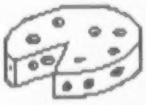
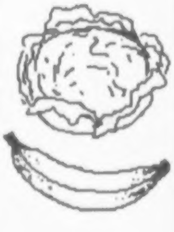
Food Product	Refrigeration		Freezing		Dry Storage	
	Temperature/ Procedure	Storage Life	Temperature/ Procedure	Storage Life	Temperature/ Procedure	Storage Life
Eggs	34°F to 40°F Refrigerate with large end up. Never wash eggs before refrigeration. Washing removes protective coating on outside of shell.	3 to 5 wk.	0°F or below Do not freeze in shell. Eggs can be frozen if removed from shell. Cooked egg whites should not be frozen.	up to 1 yr.	Not recommended	
Milk	40°F or below	up to 10 days after date marked on carton if stored properly	0°F or below Allow space in container for milk to expand as it freezes. Freezing changes appearance and flavor, not value. Thaw in refrigerator.	3 to 6 mo.	Nonfat dry milk in airtight container	6 mo.
Butter	40°F or below Store in original container.	several weeks	0°F or below May be frozen in original container.	9 mo.	Not recommended	
Cheese 	40°F or below Cover tightly and store away from sources of strong odors.	4 to 8 wk. waxed cheese will last 3 to 6 mo.	0°F or below Cut into small pieces and wrap tightly in a moisture-proof wrap. Changes in flavor and texture begin after 6 weeks. Previously frozen cheese should be used for cooking purposes.	1 to 3 mo.	Not recommended	
Fruits and Vegetables 	40°F Most can be refrigerated. Do not wash berries, cherries, and plums before refrigerating to prevent mold. Do not refrigerate sweet potatoes, mature onions, hard-rind squashes, eggplants, and rutabagas.	varies greatly	0°F or below Tomatoes, salad greens, radishes, celery, and other crisp foods lose texture. Citrus fruits do not freeze well, but juices do. Sugar should be added to fruits to stop enzyme action. Vegetables should be blanched.	9 to 12 mo.	50°F to 70°F Apples, avocados, bananas, and pears can be ripened at room temperature. Store citrus fruits at a cool room temperature. Store potatoes in ventilated containers in a cool, dry, dark place.	5 to 7 days 4 wk.

Table 16.1—Continued

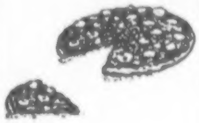
Food Product	Refrigeration		Freezing		Dry Storage	
	Temperature/ Procedure	Storage Life	Temperature/ Procedure	Storage Life	Temperature/ Procedure	Storage Life
Frozen Foods (convenience items) 	Refrigerate after cooking.	2 to 3 days	0°F or below Store promptly in original containers. Repackage if carton has been broken or if space is not available for carton.	3 to 6 mo.	Not recommended	
Canned Foods	Refrigerate after opening.	3 to 5 days	May be frozen in a plastic bag or container after opening. Do not freeze in can.	3 mo.	50°F to 70°F Store on shelves in dry area. High-acid foods such as tomatoes and pineapples have a shorter shelf life.	2 to 5 yr. 1 yr.

Table 16.1—Continued

and freezing should be followed carefully. The time periods for dry storage goods are recommendations. Dry storage goods may keep longer but will eventually lose quality. It is important to note that the guidelines in table 16.1 provide approximations of storage life of various foods. The storage life of a particular food product varies depending on many factors.

ALTITUDE AND FOOD COOKERY

Most of the populated areas of the United States are located at altitudes of 3,000 feet above sea level or less. Therefore, most recipes are written for cooking at altitudes of 3,000 feet or less. Altitudes above 3,000 feet affect the way a product is prepared and cooked, requiring adjustments in recipes and methods of cooking. The higher the altitude, the thinner the air and the lower the atmospheric pressure. The lower atmospheric pressure affects food cookery in two ways: liquids evaporate faster and boil at lower temperatures and leavening gases in baked goods expand more.

Water boils at 212°F at sea level. With each 500 foot increase in altitude, the temperature needed for water to boil drops 1°F. This means that foods cooked in water or liquid at higher altitudes require longer cooking times. Even though the food is boiling, it is boiling at a lower temperature. Altitude levels of 5000 feet or more can cause cooking problems in the thickening of starch mixtures. Figure 16.1 represents the temperature of the boiling point of water at various altitude levels.

Since the air is thinner and pressure is lower at higher altitudes, leavened products such as breads and cakes rise faster. To counteract this problem, leavening agents and sugar are usually decreased while liquid ingredients are increased. The oven temperature also requires adjusting. Often, the temperature should be increased.

Guidelines to remember for high altitude cookery include the following:

- Use slightly less baking powder.
- Use more structure ingredients such as flour.

Altitude	Temperature for the Boiling Point of Water
10,000 feet	192°F
7500 feet	197°F
5000 feet	202°F
2500 feet	207°F
sea level	212°F

Figure 16.1

- Add more water because water evaporates more readily.

Many food products, especially cake and muffin mixes, have altitude variation instructions on the product box. Several agencies and organizations can be helpful in making cooking adjustments for altitude variations. Sources include home economists at local utility companies, an extension home economist with the Cooperative Extension Service, and the local newspaper.

Summary

- ☐ The type of cooking method selected and length of time needed to cook any food depends on many factors including the type, size, shape, and weight of the food product.
- ☐ Cooking destroys harmful bacteria, organisms, and enzymes that are found in various food items.
- ☐ The amount of time needed to cook a food item depends on the temperature used, characteristics of the food item, amount of food, temperature of the food before cooking, and the speed of heat transfer characteristics of the chosen cooking method.
- ☐ Special care must be taken when cooking vegetables and fruits. Heat, baking soda, and alkalies cause vegetables and fruits to soften.
- ☐ Two cooking methods used in both commercial and home kitchens include dry-heat cooking methods and moist-heat cooking methods.
- ☐ The main advantage of cooking foods in a microwave oven is the amount of time that can be saved. Most foods can be cooked two to ten times faster in a microwave oven than in a conventional oven.
- ☐ Freezing has little if any effect on the flavor, texture, color, and nutritional value of foods.
- ☐ Refrigeration is used for short-term holding of perishable food items.
- ☐ Dry storage areas should be well ventilated, well lighted, clean, and protected from pests and excessive moisture.
- ☐ Altitudes above 3,000 feet affect the way a product is prepared and cooked, requiring adjustments to be made in recipes and methods of cooking.

Vocabulary

boiling
braising
broiling
convection ovens
dry-heat cooking methods
grilling
microwaves
moist-heat cooking methods
pressure cooking
shelf life
steaming
stir-frying
wok

Review

1. What are two examples of moist-heat cooking?
2. How do heat, baking soda, and alkalies affect vegetables and fruit?
3. What are two examples of dry-heat cooking?
4. Why are meats and poultry typically not cooked by the pressure steam method?
5. How does steam cooking affect the nutrients in vegetables?
6. When boiling foods, what is the best procedure to use for retaining nutrients, taste, color, and texture?
7. How do animal proteins react to heat?
8. What types of utensils produce the best results when cooking in a microwave oven?
9. How does a convection oven work?
10. What are the four methods recommended for defrosting frozen foods?
11. What types of food products can be stored in dry storage?
12. What is the recommended temperature range for a refrigerator? a freezer? dry storage?
13. Where could one get help to make recipe adjustments for high altitude cooking?

Critical Thinking

Gather the following items and examine under a microscope a piece of the flesh/skin from each.

- poultry frozen for one month and poultry frozen six months or more
- poultry refrigerated for one day and poultry refrigerated for one week
- fresh poultry and poultry left out overnight

What differences do you notice? Which would you prefer to eat? Why?

Visit a grocery store. Locate the thermostats in the refrigerated storage areas and freezer compartments. What are the temperatures? Are they within the safety range? What storage facilities does the grocer have in the back room? Are the storage temperatures appropriate? What consequences could there be if the temperatures are too warm?

17

Leavening Agents

ESSENTIAL ELEMENT

☐ Evaluate the effect of various leavening agents on food products.(j3F)

OBJECTIVES

☐ Identify the various ingredients of baked goods and the contributions of each.

☐ Compare and contrast the different forms of leavening agents and their characteristics.

☐ Describe the process of making yeast breads.

To leaven means to make a food light and porous by adding air and making the product rise. A ***leavening agent*** refers to air, steam, or a chemical reaction activated by another ingredient that produces carbon dioxide in a batter or dough. Carbon dioxide makes the mixture rise, become light and porous, or increase in volume. ***Carbon dioxide*** is a harmless gas that when heated causes the mixture to expand and rise.

INGREDIENTS IN BAKED GOODS

All bread products contain the same basic ingredients. These ingredients include flour, leavening agent, salt, fat, and liquid. In addition, some also contain eggs and sugar. Each ingredient contributes a special characteristic to the product. Figure 17.1 identifies the characteristics of these basic ingredients.

Breads are classified by the type of leavening agent used. There are quick breads and yeast breads. ***Quick breads*** are faster to prepare because they contain quick-acting leavening agents rather than yeast to make them rise and become light. Quick breads are leavened by baking powder, baking soda, air, or steam. These leavening agents act quickly so the product can be baked at once. Popular quick breads include muffins, corn bread, popovers, pancakes, waffles, pastries, and loaf breads.

Characteristics of Basic Ingredients

- Flour - provides structure
- Liquid - adds moisture (Milk is more nutritious than water.)
- Leavening agent - increases the volume of the product
- Salt - improves the flavor
- Fat - tenderizes
- Eggs - provides structure and some leavening
- Sugar - tenderizes, sweetens, browns

Figure 17.1

Quick breads are basically mixtures of flour, liquid, and leavening. They may be classified by their proportion of flour to liquid. The more flour in proportion to the liquid, the thicker the mixture. Thin flour mixtures are called ***batters***. Batters can be thin enough to pour or thick and sticky. Very thin batters are called ***pour batters***. They contain about one cup of flour for each cup of liquid. Pancakes, waffles, and popovers are made from pour batters. ***Drop batters*** are too heavy to pour but too sticky to handle. They contain about two cups of flour for each cup of liquid. Drop batters are used to make muffins, coffee cakes, and some biscuits and quick loaf breads.

Thick flour mixtures are called ***doughs***. Soft doughs are stiff enough to handle and roll into shapes. The usual proportion is three cups of flour to each cup of liquid. Biscuits, doughnuts, and some coffee cakes are made from soft doughs.

Unleavened breads are also considered quick breads. Unleavened breads are made without the benefit of a leavening agent such as baking soda or yeast. Unleavened breads are made from a flour mixture, water, and sometimes salt and lard. Examples of unleavened breads are listed in figure 17.2.

Yeast breads rise much more slowly than quick breads. ***Yeast breads*** contain yeast as the leavening agent. They have a pleasant and distinctive aroma, flavor, and texture. They may be made from white flour, whole wheat flour, or rye flour, or a mixture of all three. They may be plain or sweetened. Sweetened yeast breads include coffee cakes, sweet rolls, doughnuts, and Danish pastries. Yeast breads may be shaped into loaves or rolls. They may be baked in the oven or fried in deep fat. The crust may be hard or soft. A yeast dough forms the base for pizza.

Flour

Flour is used in baked goods to form the structure or the body of the bread. Flour is rich in carbohydrates called starch. Enriched flour provides B vitamins and iron.

When a liquid is mixed with the flour, gluten is formed. The ***gluten*** gives the dough or batter strength and elasticity to retain the air, steam, or carbon dioxide that is needed for the product to increase in volume. Gluten is a tough, sticky substance that is developed from wheat flour. Flour can be made from barley, buckwheat, corn, oats, rice, rye, and wheat, but only wheat has the appropriate amounts of the needed plant protein to develop gluten.

SUGAR
FLOUR

Unleavened Breads

Pita bread is also known as pocket bread. It originated in the Middle East. Pita bread is made from wheat and shaped into a round, thin form. The air pocket which forms during the baking process can be filled with lettuce, meat, or other foods to make a pocket sandwich.

Chapati is a flat, thin, unleavened bread which originated in India. Chapati is made from a mixture of water, salt, and a whole wheat flour called atta. Chapatis are baked in a hot, dry skillet.

Tortillas are flat bread which originated in Mexico. Corn tortillas are made from water and a special cornmeal rolled into a ball and pressed into a flat circle. They are cooked on both sides. Flour tortillas are made from unbleached flour, water, lard, and salt. They are kneaded, rolled into a circle, and cooked on a griddle.

Injera is a soft, white unleavened bread from Ethiopia. Injera is made from teff—a grass containing small seeds. Teff is combined with water, shaped like a large pancake, and baked. It is torn into small pieces and used to pick up pieces of spicy food.

Matzo is an unleavened bread used in Jewish religious ceremonies.

Figure 17.2

All-purpose flour purchased in stores is made from wheat. It is more refined than whole wheat flour. The two types of wheat flours are hard and soft. Soft wheat flours produce a softer gluten than hard wheat flours. Soft wheat flours are used for cakes while hard wheat flours are used for breads. All-purpose flour is made from a blend of both hard and soft wheats.

Whole wheat, graham, rye, and other specialty flours add flavor and variety to breads. Meals like cornmeal and oatmeal are used to add texture and flavor to some breads. These meals and specialty flours do not have enough gluten to develop a desirable bread structure. They should be combined with white wheat flour to ensure an adequately leavened product.

Many recipes call for the use of sifted flour. Flour can be purchased already sifted, or it can be sifted prior to being mixed with other ingredients. Sifting the flour affects the amount of volume or air that can be incorporated into the product. Several types of flour are available on the market today. Each has a different percentage of protein. The protein in the flour determines the structure of the baked good.

The amount of liquid used affects the gluten development in the product. In dry mixtures, the gluten does not develop completely. Many cookie doughs and pie doughs are somewhat dry for this reason. If too much liquid is added to the dough, it dilutes the gluten and keeps it from sticking together. Gluten develops best in a mixture that enables it to stick together. Figure 17.3 contains the formula for developing gluten. No amounts are listed because different products require different amounts of the ingredients. For example, cakes require more protein in the

Protein in Flour
+
Liquid
+
Manipulation (incorporation of air)
=
Elasticity of the Gluten

Figure 17.3

flour, more liquid, and more manipulation than cookies.

During cooking, the carbon dioxide gas expands and increases the volume of the product. As this takes place, the protein coagulates and the rigid framework or crust of the product is formed. The more protein in the flour, the stronger the structure. Stronger protein or a higher percentage of protein absorbs more water. High-protein flour needed for breads absorbs more water than low-protein flour used for cakes and cookies.

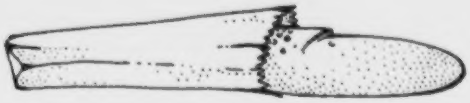
Types of flour and protein content is as follows:

• bread flour	13 percent
• all-purpose enriched flour	11 percent
• cake flour	8 percent
• whole wheat flour	14 percent
• self-rising flour (all-purpose flour with a leavening agent and salt)	10 percent

Liquid

The liquid used most often in baked goods is milk. Buttermilk or sour milk and fruit juices are also used. The liquid dissolves the dry ingredients including the chemical leavening agents. The liquid also provides some of the leavening action when the liquid is converted into steam during the cooking process.

Using water as the liquid ingredient makes the texture of the bread coarse and chewy. It makes the crust crisp. Water is used for French and Italian bread and hard rolls.



When milk is used as the liquid, it adds to the flavor, color, texture, and browning characteristics of the product. The milk gives the bread a velvety grain. Milk also adds minerals, vitamin D (calciferol), and some complete protein to the product's nutritional value.

Leavening Agents

Leavening agents are used to make baked goods rise. Leavening agents used may be chemical (baking powder or baking soda), yeast, air, or steam. Only a small amount of leavening agent is needed. Too much causes a coarse product that dries out easily. Too little leavening results in a product with a fine grain, small volume, and a rough crust. Leavening adds no nutritive value to the food product.

Salt

Salt improves the flavor of breads and strengthens the gluten. Salt keeps the yeast from growing too fast and is essential for satisfactory yeast products. It improves the texture, color, and keeping quality of the bread. Too much salt results in a firm, compact product. Salt adds no nutritive value to the product.

Fat

Fat or shortening is the ingredient that gives baked goods their tenderness. The fat used may be shortening, lard, margarine, butter, or oil. Vegetable shortening and lard can be used but have a relatively bland flavor. Butter or margarine gives baked products a pleasing flavor. The fat also increases the product's caloric value. Too much fat slows the action of yeast.

Eggs

Eggs in baked goods contribute color, texture, and nutritive value. Eggs are rich sources of nutrients including vitamins, minerals, and some complete protein. When air is beaten into eggs, the eggs act as a leavening agent. When air is beaten into egg whites, a foam is formed. The egg white surrounds the air bubbles in the foam. Egg white foams are used to leaven puffy omelets, soufflés, meringues, angel food cakes, and other foods. The air in the egg white foam expands when heated. This causes the product to increase in volume until the heat thickens the egg protein surrounding the air bubble. This makes the product light and porous.

Low temperatures are used to delay coagulation of the egg white and allow as much time as possible for the air to expand. The thinner the viscosity (solidity or thickness) of the egg white, the more it will stretch to hold more air. Egg whites at room temperature have a thinner viscosity than cold ones. Egg whites at room temperature will add more leavening power to a product.

Eggs are used as the primary leavening agent in the following food items:
- angel food cake
- chiffon cakes
- sponge cakes
- soufflés
- meringue

To ensure that as much air is beaten into the egg whites as possible, the following guidelines should be observed:
- Bring the egg whites to room temperature before beating.
- Avoid exposing the egg whites to fat (fat from the egg yolk, milk, or a greasy bowl or beater reduces the amount of air which can be beaten into the egg whites).
- Select the smallest suitable bowl with a small rounded bottom and sides that slope out to a wider top.
- To increase the stability of the foam, add cream of tartar to thicken whites and add sugar gradually after the whites reach the soft-peak stage.

The type of product desired determines the stiffness to which the egg white is beaten. The egg whites are suitable for folding into mixtures when the peak will just bend over as the beater is slowly lifted out of the foam. This soft-peak state also is used for the soft meringues used on cream pies. Additional beating causes the peak to stand up straight as the beater is lifted. Hard meringues are beaten to the stiff-peak stage. Hard meringues may be shaped into meringue shells or cookies and baked at a low temperature (250°F).

Beaten egg yolks or whole eggs help to leaven baked products that contain other leavening agents besides air. They also add moisture to form steam, adding to the leavening action. Eggs provide part of the leavening for butter cakes, muffins, and other quick breads.

Sugar

Many baked products contain sugar or syrup. Sugar in baked goods is added for its sweet flavor, tenderizing qualities, and browning capabilities. Sugar also adds to the caloric value of the food product. It helps baked products stay fresh longer. When sugar is added to a batter or dough containing yeast, it serves as food for the yeast, allowing the bacteria to grow and multiply. Too much sugar, however, may slow the action of the yeast.

The sugar used in baking may be purchased in several forms including the following:

- granulated
- brown
- powdered
- syrups such as molasses, malt syrup, honey, corn syrup, and maple syrup

FORMS OF LEAVENING AGENTS

Air and steam leaven all flour mixtures to some extent, but a leavening agent is added to the mixture to cause the expansion of the carbon dioxide gas during heating. The leavening agents may be incorporated in the batter or dough by either chemical or physical means. The type of leavening agent used to produce the gas and the amount of time required to form the gas determine the texture and other characteristics of the leavened product.

Air

Air is incorporated into a batter or dough through physical means. Air serves as a leavening agent when it is beaten or folded into a mixture through the process of beating, sifting, or creaming a product's ingredients. Air partially contributes to the volume of the leavened product. The amount of air or volume is determined by physical means or manipulation. The actual leavening process of air takes place during the heating process. Factors that affect the amount of volume incorporated through manipulation are identified as follows:

- amount of creaming
- number of times the flour is sifted
- type of shortening used
- temperature of the batter or dough
- size, grade, and number of eggs used
- mixing speed
- size of the sugar crystals
- type of mixing utensil – whether batter is mixed by hand or mixed by machine
- size of the mixing bowl in relation to the amount of batter or dough

Steam

Water turns into steam as it is heated. The water in dough or batter changes to steam as it is heated and acts as a leavening agent. Some products rely totally on steam as a leavening agent. These products are baked at higher temperatures than products using other leavening agents. Examples of products with steam as the primary leavening agent include cream puffs, pastries, doughnuts, and popovers.

Chemical Agents

Chemical leavening agents are chemicals that react with moisture and heat to form carbon dioxide. Chemical leavening agents are used in quick breads because they react quickly. Baking soda and baking powder are the two types of chemical leavening agents.

Baking Soda. ***Baking soda*** is used with some types of acidic food to produce the leavening power. The baking soda neutralizes the acid. Acidic foods include buttermilk, sour milk, sour cream, yogurt, molasses, corn syrup, honey, and chocolate. Honey, chocolate, and corn syrup have low acidity levels and cannot be used as the only source of acid in a recipe. The acidity levels of sour milk and molasses may vary with age and degree of sourness. When the baking soda and the acidic solution are mixed, carbon dioxide is formed.

The carbon dioxide reaction is immediate when the leavening agent and the acidic ingredient are mixed together. Baking soda should be mixed with the dry ingredients before being exposed to the acid ingredient. Proper amounts of baking soda in a recipe are very important. Too much baking soda causes an undesirable flavor and color and also destroys nutrients, especially thiamin.

Baking Powder. ***Baking powder*** is a combination of baking soda, dry acid or acid salts like cream of tartar, and flour or starch. Flour or starch is added to stabilize the mixture and keep it from clumping. Mixing the baking powder with a liquid causes the acid salt to dissolve and react with the soda, enabling carbon dioxide to form and leaven the product. It is used most often on quick breads. Baking powders absorb moisture while in storage and eventually lose their strength or potency. They should be purchased in small quantities and used within a reasonable length of time.

To test the leavening power or freshness of baking powder, mix one teaspoon of the baking powder with 1/3 cup of hot water. If the reaction is a bubbly mixture, the baking powder is still good.

Baking powders are classified based on their acid components. The three types of baking powders are the following:
- phosphate
- sodium aluminum sulfate (SAS)
- tartrate

The type of acid the baking powder contains determines how quickly the carbon dioxide is formed.

Phosphate baking powders contain monocalcium phosphate or monosodium phosphate. Some contain cream of tartar. Approximately two-thirds of the carbon dioxide is produced after it is combined with a liquid. The remaining one-third is produced during the cooking process. A bitter taste results if too much phosphate is added.

Sodium aluminum sulfate (SAS) are phosphate powders with acid ingredients of calcium acid phosphate or sodium aluminum sulfate. SAS releases the greatest amount of carbon dioxide when the mixture is heated. SAS is the baking powder most often sold in the grocery store.

The active ingredient in tartrate powders is baking soda, tartaric acid, and cream of tartar or potassium acid tartrate. ***Tartrate baking powders*** react instantly when mixed with a liquid. The batter or dough must be baked quickly after mixing. Tartrate baking powders are seldom used in the United States.

Baking powders also are classified according to their reaction. Powders may be single-action or double-action baking powders.

Single-action baking powders release carbon dioxide as soon as moisture is added. This is because the acid is soluble in cold water. The action speeds up when heat is applied. Because it acts so quickly, the product must be mixed, prepared for baking, and placed in the oven quickly. All tartrate and some phosphate baking powders (those containing cream of tartar) are single-action baking powders. These powders are relatively expensive and are no longer marketed in the United States. The equivalent of one teaspoon of a single-action baking powder can be made with one-half teaspoon of cream of tartar and one-fourth teaspoon of baking soda. One-fourth teaspoon of cornstarch should be added if the mixture must be stored.

Double-action baking powders require both moisture and heat to completely release all carbon dioxide. They contain a base (baking soda) and two types of acid powders—usually monocalcium phosphate and sodium aluminum sulfate (SAS). The phosphate powder can be sodium acid pyrophosphate or calcium acid phosphate or a combination of the two. The phosphate powder is soluble in cold water while the SAS powder is only soluble in hot water. Phosphate powder acts much more slowly than single-action baking powder. It releases some carbon dioxide before the mixture is heated but releases most when heat is applied. All SAS baking powders are double-action baking powders. Some phosphate powders require double action.

Commercial bakers have access to a variety of leavening agents. Special leavening agents are needed for the great variety of baked goods, frozen batters and doughs, and packaged mixes produced and marketed today.

Baking powder used in recipes must be accurately measured. Using too much baking powder causes too much carbon dioxide to be produced. Too much carbon dioxide causes the product to collapse. Using less than the amount specified does not create enough carbon dioxide for adequate leavening and results in a small, compact product. Occasionally, a recipe may specify using both baking powder and baking soda. This means that an insufficient amount of carbon dioxide will be produced from the soda and acid to leaven the product. Baking powder must also be used to provide enough carbon dioxide to leaven the product sufficiently.

Yeast

Carbon dioxide also can be formed from the combination of yeast and sugar. Bacteria cells grow through a process called fission. Cells grow or bud from other cells. This is called ***budding***. When the yeast is exposed to a certain temperature, moisture, and food, carbon dioxide is produced. Sugar is a substrate or food for yeast. The food is in the form of simple sugars from starch, granulated sugar, or both.

Yeast feeds on starch and sugar. It grows best at temperatures between 78°F and 85°F. The yeast dies at temperatures above 140°F. Yeast grows in a moist environment with adequate food and the correct temperature. It produces carbon dioxide which slowly stretches the dough and causes it to rise. This process takes several hours.

Yeast is available in two forms: compressed yeast and active dry yeast. ***Compressed yeast*** is in an active state. Compressed yeast also is known as fresh yeast or cake yeast. It is packaged as a moist mixture of the yeast and starch or sugar. Compressed yeast keeps for four or five weeks in the refrigerator. It spoils quickly if exposed to temperatures above 60°F.

Active dry yeast has basically the same ingredients as the compressed yeast only it has been dried and packaged in a granular form. The sealed envelope packaging is dated to ensure freshness. It does not require refrigeration but should be stored on a shelf in a cool, dry area.

Making yeast breads involves ten basic steps. Each step is described in figure 17.4.

Making Yeast Breads

1. **Measuring.** Be accurate.
2. **Mixing.** Use the straight-dough method, sponge-dough method, or batter method (described in Chapter Fourteen) to combine the ingredients and develop the strength of the gluten.
3. **Kneading**. Fold, press, and squeeze the dough to develop the strength of the gluten.
4. **Fermenting.** Carbon dioxide is formed in this stage. Allow the dough to rise in a warm place (80°F to 85°F) until double in size in a warm place.
5. **Punching.** Fold the dough from the sides to the middle and press to expel the gas bubbles and remix the ingredients so the yeast can grow again.
6. **Resting.** Allow the dough to relax for ten to fifteen minutes to make it easier to handle.
7. **Makeup.** Prepare the dough for baking by scaling, rounding, and shaping. ***Scale*** or divide the dough into sections. ***Round*** each section into a smooth mound and allow it to rest for 10 minutes. ***Shape*** the dough into loaves or rolls.
8. **Panning.** Place the dough in the pans for baking.
9. **Proofing.** Allow the dough to rise a final time before baking. A temperature of 100°F and a humidity level of 80 to 85 percent are ideal for the rising dough.
10. **Baking.** Cook the dough in the oven to kill the yeast, harden the gluten, and brown the sides and the top.

Figure 17.4

Air is a major component of the structure of yeast doughs. Air allows the dough to maintain its shape. This makes yeast doughs fragile. Pans of dough must be handled carefully to prevent damage to the structure of the dough. If the structure is damaged, it may collapse. Once transferred to an oven safely, the heat of the oven speeds the growth of the yeast for the first fifteen minutes. Then, the gluten and starch begin to coagulate, making the product firm. The sugar in the dough causes the crust to brown and become glossy or bloom.

Important points to remember when making yeast breads include the following:
- Measure ingredients carefully.
- Too much sugar or salt will interfere with the development of the gluten.
- Too much flour will make the dough too stiff.
- A temperature that is too hot will destroy the yeast.
- A temperature that is too cold will slow the growth and action of the yeast.
- Dough should be kneaded sufficiently to develop the gluten with enough elasticity and strength to retain the carbon dioxide.

Causes of failure in yeast breads are listed in figure 17.5.

Causes of Failure in Yeast Breads

- Poor volume results from adding liquid that is too hot and kills yeast.
- Insufficient kneading results in a product with poor volume.
- Omitting sugar will result in a product with poor volume.
- Insufficient rising will result in a compact, less tender product with poor volume.
- Too much rising will result in a product that is coarse and sour.

Figure 17.5

Another form of yeast bread is a sourdough bread. It is made with a leavening agent called a sourdough starter. The starter is a mixture of flour, yeast, and water. The mixture is fed weekly with a sugar and or potato water mixture. The mixture is kept alive by the weekly feedings and refrigeration.

Sweet yeast breads include sweet rolls, doughnuts, and Danish pastries. They are made from a very rich dough and are sweeter, more tender, and less chewy than other yeast breads. The dough has a higher proportion of sugar, shortening, and eggs to flour. Danish pastries contain twice as much shortening as other sweet yeast breads.

Sweet doughs are mixed by a different method than other yeast doughs. The shortening, sugar, salt, and flavorings are creamed or mixed together until fluffy. Liquid milk or dry milk solids are added and the mixture is creamed again. Eggs are added one at a time and beaten at medium speed. Yeast may be softened and added to the milk mixture, or dry yeast may be mixed with the last addition of flour. The flour is added gradually and mixed thoroughly on low speed after each addition. The dough is then kneaded for several minutes at medium speed. A temperature of 78°F to 82°F must be maintained while mixing the dough because of the low gluten content. Too much mixing causes the temperature to rise. Overmixing causes the dough to become sticky and difficult to handle. Proper mixing results in a smooth, elastic dough. Sweet dough is allowed to rise less than other yeast dough. Less fermentation is required because of its high sugar content.

Summary

- A leavening agent refers to air, steam, or a chemical reaction activated by another ingredient that produces carbon dioxide in a batter or dough. Carbon dioxide makes the mixture rise, become light and porous, or increase in volume.
- Breads are classified by the type of leavening agent used. They are either quick breads or yeast breads.
- Flour can be made from barley, buckwheat, corn, oats, rice, rye, and wheat, but only wheat has the right amounts of the right plant protein to develop gluten.
- During the cooking process, carbon dioxide expands and increases the volume of the food product. As this takes place, the protein coagulates and the rigid framework or crust of the product (such as bread) is formed.
- The type of leavening agent used to produce the gas and the amount of time required to form the gas determine the texture and other characteristics of the leavened product.
- Baking soda and baking powder are chemical leavening agents that react with moisture and heat to form carbon dioxide.
- Baking powders are classified based on their acid components. The three types of baking powders are phosphate, sodium aluminum sulfate (SAS), and tartrate. SAS is the baking powder most often sold in the grocery store.
- Baking powders are also classified according to their reaction. Powders may be single-action or double-action baking powders.
- Yeast is available in two forms: compressed yeast and active dry yeast.

Vocabulary

active dry yeast
baking powder
baking soda
batters
budding
carbon dioxide
compressed yeast
double-action baking powders
phosphate baking powders
pour batters
quick breads
round
scale
shape
single-action baking powders
sodium aluminum sulfate (SAS)

doughs
drop batters
gluten
leavening agent
sweet yeast breads
tartrate baking powders
yeast breads

Review

1. Identify the seven basic ingredients of bread products and their functions.
2. How are quick breads and yeast breads different?
3. Why is flour used in baked goods?
4. What is all-purpose flour?
5. How does using milk as the liquid ingredient in a baked good affect the final product as compared to using water as the liquid ingredient?
6. When beating egg whites, what steps can be taken to ensure that as much air as possible is incorporated?
7. Why is salt used in baked good products?
8. What factors affect the amount of volume incorporated for leavening through physical means or manipulation?
9. How are baking powders classified?
10. What happens if too much baking soda is added to a product?
11. In what ways are yeast breads and sweet yeast breads different?
12. What are three causes of failure in yeast breads?

Critical Thinking

Locate various chemical leavening agents (brands and types) at school, home, and at the grocery store. Which are used most often (phosphate, sulfate, tartrate)? Locate an assortment of boxed convenience products such as cake and muffin mixes. Look at the ingredients list. What is the leavening agent used in each product? Which leavening ingredient is used most often? Why?

18

Principles of Protein, Vitamin, and Carbohydrate Cookery

ESSENTIAL ELEMENT

- ☐ Analyze principles of protein, vitamin, and carbohydrate cookery.(j3G)

OBJECTIVES

- ☐ Identify the various functions of eggs in the cooking process.
- ☐ Compare similarities and differences of meat, fish, and poultry cooking methods.
- ☐ Differentiate legume preparation techniques with the preparation techniques of other protein foods.
- ☐ Discuss factors to consider when cooking with cheese and milk.
- ☐ Evaluate various cooking methods and their effects on vitamins.
- ☐ Review the effects of cooking methods on carbohydrates.

Protein, vitamins, and carbohydrates react to heat differently, and various cooking methods affect them differently. Each has characteristics that make its preparation requirements unique. It is important to know proper procedures and principles of cooking to adequately prepare foods for maximum flavor, appeal, and nutrient retention.

FACTORS AFFECTING PROTEIN COOKERY

Protein is sensitive to heat. High cooking temperatures make protein foods tough and dry. Low temperatures allow the protein to coagulate or thicken and hold in its natural juices. Protein foods include eggs, meat, fish, poultry, legumes, cheese, and milk.

Eggs

Protein is the most prevalent nutrient found in eggs. The protein is concentrated in the yolk of the egg. An egg consists of a white and a yellow portion contained in a shell. The white portion is called the ***albumen***. The yellow portion is called the ***yolk***. The yolk is held in place by the ***chalaza***, which is twisted, cordlike strands of heavy egg white. In the large end of the egg is an air cell. A freshly laid egg has no air cell. As moisture evaporates from an egg, the air cell is formed. The older the egg, the larger the air cell.

The shell of an egg is porous. It permits moisture and gases to pass through. On the outside of the shell, a thin film called the ***bloom*** helps to seal the pores and protect the egg from contamination. The color of the shell may be white to brown depending on the breed of chicken that laid the egg. The color of the shell does not affect the egg's nutritive quality.

The freshness or quality of an egg is judged by a process called ***candling***. The candling process involves placing an egg on rollers over high intensity lights that make the interior of the egg visible to the grader (inspector). The eggs are rotated on the rollers so that the entire contents can be viewed. The outline of the egg yolk and the size of the air cell are examined. The freshest egg, Grade AA, has a thick egg white which supports a rounded, firm egg yolk. The air space at the wide end of the egg is small. Anyone can check the quality of an egg by holding it up to a bright light to determine the size of the air space. The smaller the air space, the fresher the egg.

Forms of Eggs Available. Eggs may be purchased fresh, frozen, and dried. Whole eggs, whites, and yolks may be processed in liquid, frozen, and dried forms.

Fresh eggs may be purchased in the shell. Fresh, whole eggs are washed before being packaged. After they are washed, the eggs are sprayed with a fine mist of oil to reseal the pores and prevent loss of moisture through the shell. Liquid eggs may be purchased in cans whole, yolks only, or whites only. ***Fortified eggs*** are a mixture including more egg yolks than egg whites.

Frozen eggs are often less expensive than liquid whole eggs. Frozen eggs also may be purchased whole, yolks only, or whites only. Frozen eggs must be kept frozen until ready to be thawed and used. Thawed frozen eggs and reconstituted dried eggs are highly perishable. Careful handling is essential to prevent contamination. Frozen eggs should be stored in the freezer at 0°F or below and thawed in the refrigerator. Thawed eggs should be used immediately, or they should be stored in the refrigerator in a tightly sealed container and used within twenty-four hours.

Dried eggs are available whole, yolks only, or whites only. Dried eggs are vacuum packed or packed without air. Unopened packages of dried eggs should be stored in a cool, dry place or in the refrigerator. The storage temperature should be no higher than 50°F. After opening, any unused portion in a container should be refrigerated in an airtight container. Only the amount needed should be reconstituted (mixed with the right amount of water to return it to its original form) at any one time. Reconstituted eggs should be used immediately, or they should be refrigerated in an airtight container and used within one hour.

Eggs have a high cholesterol content. Food technologists have developed egg substitutes primarily for individuals who must control their intake of cholesterol and fat. Egg substitutes are lower in fat, cholesterol, and calories. Egg substitutes are available in two forms: complete egg substitutes and partial egg substitutes. The ***complete egg substitute*** contains no egg and is made from soy bean or milk proteins. The ***partial egg substitute*** includes egg whites, vegetable oil, and nonfat dry milk. It does not contain yolk due to the yolk's high concentration of cholesterol. Many of these substitutes can be purchased in liquid, frozen, and dried forms.

The flavor of egg substitutes is different from that of real eggs. However, egg substitutes do blend well with other ingredients. They can be substituted for whole eggs in recipes and can be used alone for scrambled eggs or omelets. Milk protein egg substitutes are not suitable in some recipes because they do not provide the thickening power of real eggs. Cakes made with egg substitutes do not rise as well as cakes made with real eggs.

Egg Cookery. Eggs coagulate or thicken when they are cooked. The degree of coagulation depends on the product, the cooking temperature, and the length of cooking time. This makes them good products to use as thickeners for foods such as puddings, custards, and sauces. Low temperatures must be used or the product may curdle or develop a tough texture. Overcooking also causes the product to curdle. When eggs are heated, the protein coagulates and makes the structure of the egg become tender yet firm. If the heating process continues for too long or if the temperature is too hot, overcoagulation occurs making the protein become tough and rubbery. This is true not only of eggs, but of all protein foods whether meat, milk, or cheese.

Eggs can be used as main dishes or as ingredients in a variety of recipes. When eggs are used alone, they should be of high quality. Eggs may be used as ingredients to bind, emulsify, thicken, coat, or leaven. When used as an ingredient in a recipe, eggs contribute the following:

- nutritive value
- color, flavor, and texture
- leavening capabilities
- emulsifying capabilities
- binder of foods
- a coating for foods that are fried

Eggs contain complete protein, which includes all amino acids needed by the body. They can be substituted for meat. Two eggs equal one 2 to 3-ounce meat serving. Figure 18.1 identifies the nutrients in the yolk and white of an egg in order of predominance.

When air is beaten into eggs, they act as a leavening agent. Egg white foams are used to leaven puffy omelets, soufflés, meringues, angel food cakes, and other foods. Beaten egg yolks or whole eggs also help to leaven baked products that contain other leavening agents besides air. They also add moisture to form

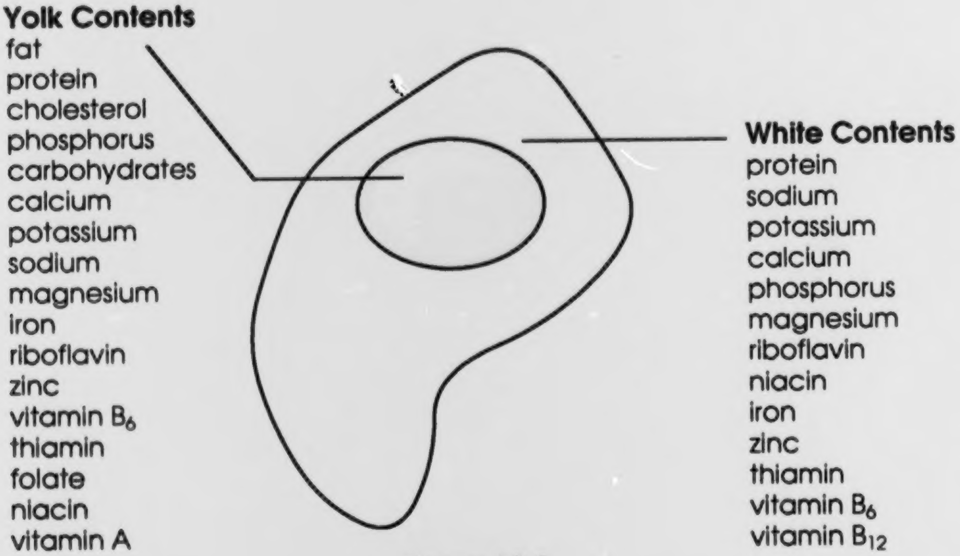

Yolk Contents
fat
protein
cholesterol
phosphorus
carbohydrates
calcium
potassium
sodium
magnesium
iron
riboflavin
zinc
vitamin B_6
thiamin
folate
niacin
vitamin A
White Contents
protein
sodium
potassium
calcium
phosphorus
magnesium
riboflavin
niacin
iron
zinc
thiamin
vitamin B_6
vitamin B_{12}

Figure 18.1

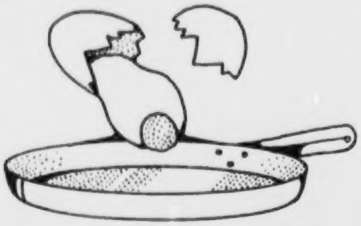
steam, adding to the leavening action. For more information regarding eggs as leavening agents, refer to Chapter Seventeen.

Eggs are also emulsifiers. Emulsifiers hold oil and another liquid together so that the oil is distributed evenly throughout the mixture. Without the emulsifier, the oil and liquid would separate and the oil would rise to the top. When eggs are used as emulsifiers, the egg yolk forms a film around the particles of oil keeping it suspended in the liquid. Mayonnaise is an example of a permanent emulsion in which eggs serve as the emulsifier. The eggs hold the oil and vinegar or lemon juice together.

As a binder, eggs are used to hold other ingredients together. Eggs hold the ingredients in foods like meat loaf and salmon croquettes together. Since only a small portion of the ingredients is egg, higher temperatures may be used.

Foods to be fried may be dipped in a beaten egg mixture then coated with bread crumbs, flour, or cornmeal. The eggs cause the crumbs to stick to the food. Cutlets, fish fillets, and other foods are coated in this manner then cooked in hot fat or fried.

The high protein content of eggs dictates the principles of egg cookery. As with all protein, low to moderate temperatures and short cooking times are necessary. High temperatures and overcooking cause the protein to toughen, curdle, and discolor.



Eggs are hard-cooked not hard-boiled. Eggs should not be cooked in boiling water but should be simmered. The use of boiling water could cause overcooking. Overcooked eggs develop a dark green ring around the yolk. This discoloration is due to the interaction of the iron and the sulfur in the egg. High temperatures and overcooking also make the egg whites rubbery. To prevent this discoloration, the following should be observed when hard-cooking eggs:

- Simmer eggs for fifteen minutes instead of boiling them.
- Avoid overcooking eggs.
- Cool eggs immediately after cooking them the appropriate amount of time by placing them under cool, running water.

Cooking eggs in the microwave oven requires special precautions. Eggs should never be cooked in the shell in the microwave oven. Because the fat content in the egg yolk causes it to cook faster than the egg white, the pressure builds from the yolk and causes the egg to explode. Eggs should be broken and placed in a small microwavable dish. The yolk should be pierced and the bowl covered tightly. Eggs cooked alone should be cooked on a low setting. Higher temperatures can be used when eggs are used as ingredients in such products as casseroles.

Storage of Eggs. The quality of eggs begins to decline as soon as they are laid. As eggs deteriorate in quality, the white becomes thinner, the yolk flattens, and the air space increases. Proper storage can slow this process. Fresh eggs should be kept refrigerated until they are used. Eggs should be stored in the refrigerator with the pointed end down, away from heat and light. Eggs retain their high quality for weeks at temperatures of 35°F to 45°F. Their quality declines rapidly at room temperature.

Most egg dishes should be served immediately. Hard-cooked eggs in the shell may be kept safely for several weeks in the refrigerator. Cream, custard, or meringue pies or goods with custard fillings should be refrigerated immediately after preparation. Refrigeration helps prevent the growth of salmonella (bacterium that causes a type of food poisoning). For more information on the grading of eggs, their preparation, and their storage, refer to Chapter Twelve.

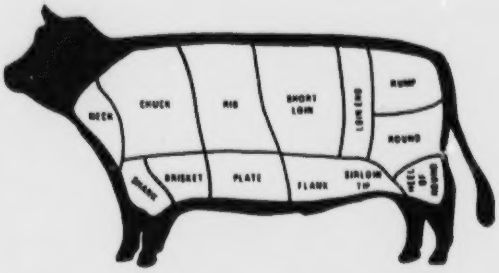
Meat

Meat is an excellent source of complete protein, B vitamins, and iron. It is difficult to obtain sufficient amounts of iron if meat is not included in the diet. However, fat and cholesterol are also present in meat. Many people avoid eating much meat because of a desire to lower fat and cholesterol intake. Trimming off the excess fat on meat reduces the fat content as well as the cholesterol content.

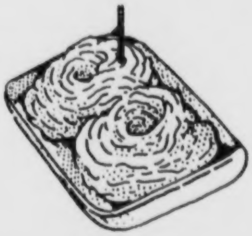
In general, the term meat refers to beef, veal, pork, lamb, or mutton. ***Beef*** is flesh from fully grown steers, cows, or bulls. Beef used for slaughter is typically from steers. Steers are castrated or neutered bulls (male cattle). The meat from steers is more tender than that from a bull or cow. Occasionally female cows are used for slaughter if they have been injured or are no longer able to produce offspring. ***Veal*** is the flesh from baby calves. ***Pork*** is the flesh of pigs or hogs. Pigs are young swine that have not matured and weigh less than 120 pounds. Hogs refer to swine that weigh more than 120 pounds. ***Lamb*** is the flesh of young sheep that are less than one year old. ***Mutton*** is the flesh of a grown sheep. Meat from these sources is often called red meat to distinguish it from poultry and fish.

Meat is made of muscle, connective tissues, fat, and bone. ***Muscle*** is composed of fibers. The fibers are held together by ***connective tissue***. The amount of connective tissue affects the tenderness of the meat. The more connective tissue, the less tender the meat. Fat is found in layers on the surface of the meat and in small flecks or streaks throughout the muscle. The small flecks of fat are called ***marbling***. ***Bone*** is part of the skeleton of the animal. The amount of bone in meat depends on the cut of meat.

Cuts of Meat. Cuts of meat can be classified into three groups: tender cuts, less tender cuts, and variety meats. The tenderness of each cut is related to its location on the animal. ***Tender cuts*** include the loin and ribs of beef, veal, lamb, and pork. They also include the leg of veal, lamb, and pork. Less tender cuts include the round, rump, flank, and chuck of beef. The shoulder and breast of veal and lamb are ***less tender cuts***. The shoulder of pork is also a less tender cut of meat. ***Variety meats*** (organ meats) include the liver, kidney, heart, tongue, and brains of beef, veal, lamb, and pork. The sweetbreads (the thymus or pancreas) of beef, veal, and lamb are other variety meats. Liver is the most popular variety meat.



The less tender parts of the animal may be cubed or ground. Ground meat is often made from trimmings and cuts of meat that cannot be sold. Ground beef is purchased by the percent of lean meat to fat. The maximum fat content is limited by law to 30 percent. Hamburger meat is usually, but not always, ground beef. Unless it is labeled "pure ground beef" it may contain some pork. Ground pork is often made into sausage.



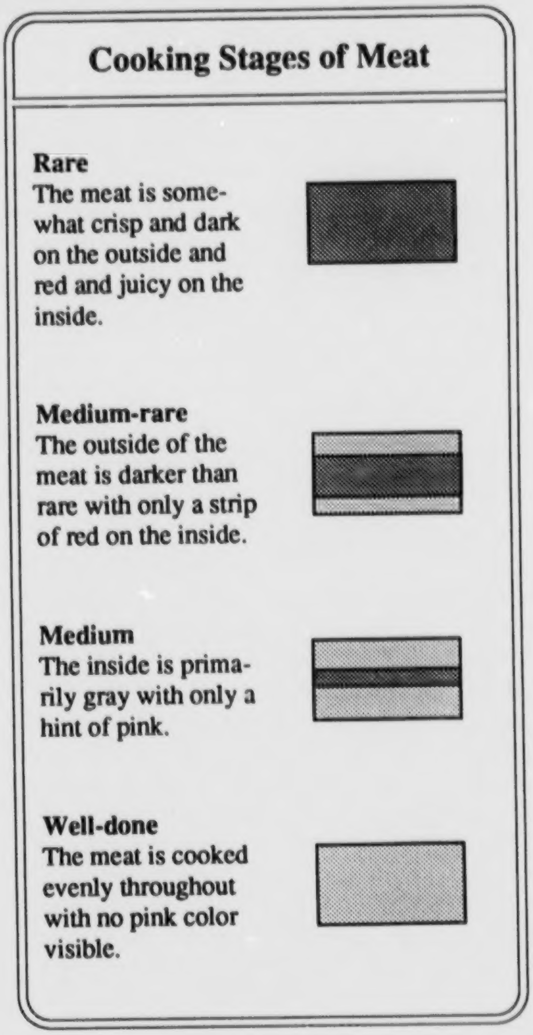
Meat Cookery. Meat requires little preparation before cooking. Different methods of cooking are used for tender and less tender cuts of meat. Less tender cuts of meat may be tenderized by chemical or physical means or by cooking. A commercial powder or liquid tenderizer containing the enzyme ***papain*** may be used to chemically break down the connective tissue in the meat. Another chemical means for tenderizing meat is by marinating. Meat is soaked for several hours in an acid food like tomato juice, vinegar, or lemon juice to break down the connective tissues. Some meats are tenderized by a chemical that is injected into the bloodstream of the animal which breaks down the connective tissue. These meats are more tender than other meats. The tenderizing chemical is injected into the animal's body shortly before it is slaughtered and is carried throughout the animal's body in the bloodstream.

Connective tissue can be broken down physically by cutting, grinding, scoring, or pounding the meat. ***Grinding*** is crushing meat into bits as with a meat grinder. ***Scoring*** is done by making shallow cuts across connective tissues. ***Pounding*** is done with a mallet that has sharp points to break down the connective tissue.

Cooking meats improves the flavor, appearance, and tenderness. It also destroys harmful microorganisms. Cooking coagulates or hardens the protein in the lean part of the meat while it softens the protein of the connective tissues.

Meats are cooked to different stages depending on the type of meat, the person cooking the meat, and the preference of the individual who will eat the meat. The four basic cooking stages are rare, medium-rare, medium, and well -done. Figure 18.2 identifies the characteristics of each stage.

Pork and veal always should be cooked to the well-done stage. Pork always should be cooked well because of possible trichina parasites that might be present. Trichina are small wormlike parasites that are in the larval state. They are occasionally found in the flesh of pork. Trichinosis is a disease that can result if these parasites are not destroyed through the heat of the cooking process and are ingested. Veal must be cooked to the well-done stage to develop flavor.



Cooking Stages of Meat

Rare
The meat is somewhat crisp and dark on the outside and red and juicy on the inside.

Medium-rare
The outside of the meat is darker than rare with only a strip of red on the inside.

Medium
The inside is primarily gray with only a hint of pink.

Well-done
The meat is cooked evenly throughout with no pink color visible.

Figure 18.2

Meat may be cooked with one of three types of heat: dry, moist, or in fat. Dry-heat is used for cooking tender cuts of meat. Dry heat cooking methods do not require the use of additional fats or liquids. Examples of dry-heat methods of cooking include the following:

- Roasting is baking large cuts of meat in the oven at 300°F to 350°F without the addition of moisture. The meat is placed fat side up on a rack in a shallow, open pan. The rack allows the heat to circulate around and over the meat for even heating. Salt can be added to the meat before it is cooked. The salt will only penetrate about one-half inch into the meat giving the roast a pleasant crust.

- Broiling is cooking by direct heat from hot coals, a gas flame, or a glowing electric element. The cooking temperature is controlled by the distance the meat is placed from the heat source. Meat selected for broiling should be three-fourths to one inch in thickness and placed three to five inches away from the heat source. When the meat is cooked on one side, it should be turned over to allow the other side to brown. If the meat is to be salted, the salt should be added after the meat has cooked because the salt will interfere with the browning of the meat. The salt also draws the natural juices out of the meat where they will evaporate, resulting in a dry piece of meat.
- Grilling or panbroiling is used for small, tender cuts of meat. The meat is placed on the solid surface of a grill or hot plate, cooked on one side, then the meat is turned over and cooked on the other side. Usually no additional fat is needed.

Moist heat is used for cooking less tender cuts of meat. Moist-heat methods tenderize the meat by cooking it slowly in moisture at low temperatures. Beef short ribs, Swiss steak, pepper steak, and beef pot pie are examples of less tender cuts of meat that may be cooked in one of the moist-heat methods. Examples of moist-heat cooking methods include the following:

- Braising is cooking meat in a covered pan in its own juice or with a small amount of added liquid. The meat can be browned slightly before the liquid is added. This method can be used for all less tender cuts of meat as well as for tender cuts of pork and veal.
- Stewing is cooking meat covered with water or other liquid and simmering or stewing until tender. Less tender cuts of meat and variety meats are cooked by this method.

Foods cooked in fat can be cooked in a small amount of fat or in a large amount of fat. Foods cooked in fat cook at a higher temperature than other cooking methods. Methods of cooking in fat include stir-frying, pan-frying, and deep-fat frying. Very little fat or oil is used in stir-frying. The food cooks quickly, allowing its natural flavor to emerge. Pan-frying is also known as sautéing. The meat can be coated with a batter and crumbs to create a crust or it can be pan-fried without a coating. A small amount of fat is melted in the bottom of a frying pan, and the meat is placed in the melted fat. One side is cooked, then the meat is turned over and the other side is cooked. Deep-fat frying is achieved by totally immersing a coated piece of food into hot fat. For more information regarding cooking in fat, refer to Chapter Nineteen.

Variety meats, also called organ meats, are more perishable than other meats and should be cooked soon after purchase. Table 18.1 identifies ways various variety meats should be cooked.

Ways to Cook Variety Meats

Variety Meat	Cooking Method
Brains	Braise, broil, cook in water, or fry
Heart	Braise, cook in liquid
Kidney (lamb and veal)	Broil
Kidney (beef)	Braise or cook in liquid
Liver	Fry, braise, broil, pan-broil or pan-fry
Tongue	Moist heat

Table 18.1

Microwave Cooking of Meats. Cooking meats in the microwave oven results in less shrinkage than cooking in a conventional oven. Containers used for cooking meat in the microwave oven should be just large enough to hold the cut of meat and the liquid or juices. The meat should be cooked on a higher power setting first for browning purposes, then the power should be reduced to allow for adequate cooking of the inside of the meat. The meat should have an even shape or be cut into similar sized pieces. As with conventional cooking, the meat should be allowed to stand after the power has been turned off to allow it to absorb the natural juices and complete the cooking process. The following are other procedures for cooking meat in the microwave oven:

- Meat should be completely defrosted before cooking begins in order to ensure even cooking.
- Chops and steaks can be scored (cut diagonally) to prevent the edges of the meat from curling.
- Bacon should be covered with a paper towel to avoid splattering.
- Meat for stews should be completely immersed in the cooking liquid.
- Meat should be rotated during both the defrosting and cooking stages at least once halfway through the cooking process.
- Fat that drips from the meat during the cooking process should be removed often. If not, the microwave will direct its power to the fat instead of the meat.

Fish

Fish, like meat, poultry, milk, and cheese, is rich in protein. Fish contains little connective tissue and cooks quickly unlike meat containing substantial connective tissue, which requires a longer cooking time. Sufficiently cooked fish is easily flaked with a fork.

The method for cooking fish depends on the type of fish being cooked (finfish or shellfish), whether the fish is frozen or fresh, the amount of fat in the fish, and the preparation needed before cooking. Finfish are fish with scales and fins such as halibut and catfish. Shellfish are fish with hard shells such as shrimp and lobster.

Fish cooks quickly because it is naturally tender. Cooking improves the appearance of fish and brings out its flavor. Moderate cooking temperatures should be used to prevent overcoagulation of the protein. Overcoagulation makes the fish tough. The fish is cooked when the flesh looks milky white and separates easily with a fork.

Finfish Cookery. Fresh finfish may be purchased in several forms. They may be purchased whole, dressed, as steaks, and as fillets. ***Whole fish*** is sold just as it is taken from the water with the entrails (inner parts) in tact. ***Dressed fish*** is a whole fish with the internal organs, scales, head, tail, and fins removed. ***Fish steaks*** are cross-section slices from a large dressed fish. ***Fillets*** are boneless lengthwise cuts from the sides of the fish along each side of the backbone. If a piece of skin is left to hold the two sides together, the cut is called a ***butterfly***. The shape of the piece resembles a butterfly. Only small, thin fish can be cut in a butterfly. Figure 18.3 displays forms of fish.

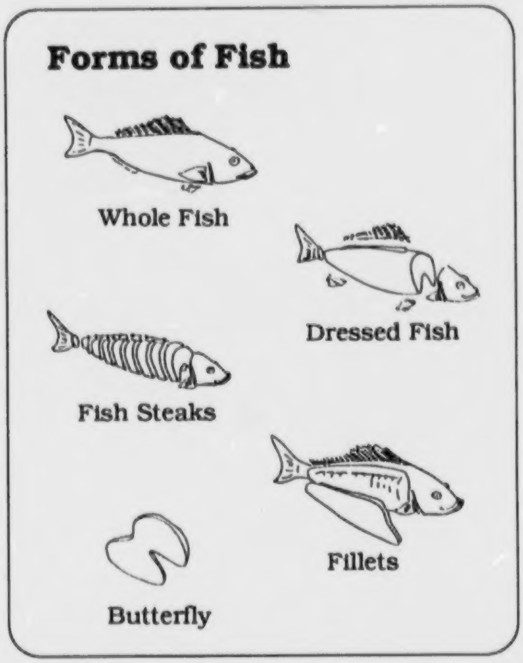


Figure 18.3

Finfish are cooked by baking, poaching, steaming, broiling, sautéing, and deep-fat frying. The method of cooking is most influenced by the amount of fat in the fish. Fat fish are those containing up to 20 percent fat. Fat fish are usually cooked by broiling, barbecuing, or baking. Examples of fat fish include the following:
- catfish
- eel
- herring
- mackerel
- mullet
- salmon
- sardines
- tuna
- trout
- other colored fish (fish with pink flesh, not gray or white)

Lean fish are better for steaming, sautéing, and deep-frying. Lean fish contain between 2 and 6 percent fat. Examples of lean fish include the following:
- cod
- flounder
- haddock
- halibut
- red snapper
- swordfish

The cooking method for finfish also is influenced by the size and thickness of the piece. Large, whole fish may be baked or stuffed. They also may be steamed or poached. ***Poaching*** refers to strapping the fish in cheesecloth to keep it from breaking apart and simmering it in seasoned water in a covered pan. Small, whole fish may be sautéed or pan-fried. Fish steaks and fillets may be broiled, sautéed, baked, or fried.

It is often a good idea to make several diagonal cuts or slits on both sides of a whole fish prior to cooking. These cuts or slits will help prevent the side closest to the heat source from curling up. For even cooking, fish should lie flat during the cooking process.

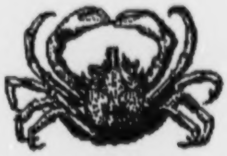
When broiling fish, it is beneficial to brush the fish with oil or butter before cooking. The oil or butter helps hold in the moisture of the fish and helps create a crisp skin. The coating of oven-fried fish also helps hold in the moisture and absorbs the heat needed to cook the meat.

Shellfish Cookery. Examples of shellfish include the following:
- clams
- crab
- lobster
- oysters
- scallops
- shrimp

Appropriate cooking methods for shellfish vary. Medium-sized shrimp are usually boiled or steamed and served whole and cold as shrimp cocktail or on a salad. Small shrimp are used in casseroles or salads. Regardless of the cooking method used, care should be taken not to overcook shrimp. They should be cooked until they turn pink. Overcooking makes shrimp tough, tasteless, and dry.

shrimp cocktail

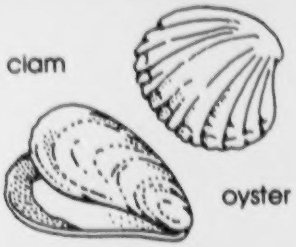
Lobsters may be boiled, broiled, baked, sautéed, or deep-fried. Lobsters can be stuffed before being baked. Crab should be boiled or deep-fried.



crab

lobster

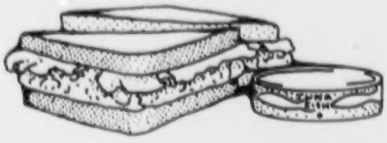
Scallops may be sautéed or deep-fried. Clams may be breaded and fried whole or in strips or diced and formed into shapes or patties. Oysters can be baked, stewed, or fried.



Convenience Fish Products. A variety of convenience fish products are available. The convenience forms of frozen fish include the following:

- frozen fillets
- steaks
- fish sticks
- fish pies
- chowders (soup or stew made with seafood, milk or tomatoes, and vegetables)

Frozen processed fish products may be breaded and ready-to-cook, or they may be precooked and require only heating before being served. Canned fish may be used as it comes from the can in salads and in sandwiches. It also may be used as an ingredient in any recipe that calls for cooked fish such as salmon croquettes. Smoked fish are ready-to-eat.



Microwave Cooking of Fish. Both finfish and shellfish have a high moisture content. This makes them good candidates for microwave cooking. Fish cook quickly in the microwave oven and should be cooked only until the meat looses its translucent or shiny appearance and becomes white or dull in color. Fish, like meat, will continue to cook even after the power has been turned off, making timing a critical factor. Fish should be rotated or turned at least twice during cooking because of their uneven shape.

Many convenience fish foods also can be cooked in the microwave. Most product packages available today give directions for microwave cooking. If not, breaded fish should be cooked uncovered. All other fish dishes should be covered during the cooking process to the help retain moisture. Many product containers are safe for use in the microwave oven.

Poultry

Poultry is the term used to describe domestic birds raised for food. Common types of poultry include chickens, turkeys, ducks, and geese. The most common types of poultry are chicken and turkey.

The following are the classifications of chickens:

- A ***broiler*** is a young bird of either sex weighing one to two and one-half pounds. It is small and has little meat in proportion to bone.
- A ***fryer*** is a young bird of either sex weighing 2 1/2 to 3 1/2 pounds. It is meaty and has some fat under the skin.
- A ***hen*** is an older female (less tender).
- A ***roaster*** is a male bird that weighs more than three and one-half pounds. It is very meaty and has a layer of fat beneath the skin. Roasters are usually cooked whole.
- ***Capon*** are young castrated or neutered males that weigh four to seven pounds. They have a high proportion of white meat and usually are roasted.
- ***Stewing hens*** are heavy, mature birds that weight four to six pounds. The meat is flavorful but less tender than that of younger birds. Stewing hens are usually braised or stewed.

Turkeys are classified as broilers or roasters. The following are turkey classifications:

- Broilers are young turkeys of either sex weighing 3 to 7 pounds and having little fat.
- ***Roaster toms*** are male turkeys weighing 8 to 25 pounds.
- ***Roaster hens*** are female turkeys weighing 3 to 15 pounds. Roaster hens have more fat than roaster toms.

The older the bird, the more developed the flavor of poultry. With age, the bird also develops tougher muscles. Age results in a more flavorful yet tougher meat. Young birds have not had time to develop much flavor or strength. Younger birds are more tender but less flavorful. The age and sex of the bird are the primary factors affecting flavor and tenderness. Older birds are less tender but more flavorful than younger birds. The young tender birds can be cooked with dry heat while the older, less tender birds need moist heat. Female birds tend to be smaller and more tender than male birds, which are generally larger.

Poultry Cookery. The classification of poultry gives a good indication of the appropriate methods of cooking. Very young chickens and turkeys may be broiled. Very young chickens also can be fried. Fully mature chickens and turkeys can be roasted. Older mature chickens should be braised, fricasseed, or stewed. Fricasseed refers to the process of stewing cut up pieces of meat in a stock and serving it in a white sauce.

Poultry may be purchased whole or in parts. It is available fresh, frozen, or canned. Fresh poultry is sold dressed and ready to cook. ***Dressed poultry*** refers to poultry from which the feathers, head, feet, internal organs, and blood has been removed. The liver, heart, and gizzards (known as giblets) are washed and placed in a bag then placed inside the body cavity of the bird. It may be sold whole, in half, or in pieces such as breasts, thighs, and legs. Whole birds such as turkeys and Cornish hens are often sold frozen. Pieces and cooked poultry pieces also are sold frozen.

Poultry can be marinated (soaked in a flavorful, acidic sauce) to add flavor and to tenderize. Marinating poultry at room temperature for even ten or twenty minutes is not recommended because it promotes spoilage. Poultry can be marinated in the refrigerator safely, but it should not be marinated for more than two hours. Marinating for more than two hours can overtenderize the meat as well as change the texture of the meat to a mushy consistency.

Poultry can be prepared in a variety of ways. Chicken has gained recent popularity in convenience foods in the form of chicken bits or nuggets. Sliced chicken and turkey are common sandwich ingredients. Roasted turkey is the traditional entree for Thanksgiving dinner. Fried chicken is a popular convenience food. Baked chicken is a favorite main dish. Specialty poultry entrees include Cornish hen, pheasant, and duck. Stewed chicken is an ingredient in many casseroles. The white meat of chicken and turkey is popular as a main dish salad ingredient.

Eating rare or raw poultry should be avoided. It is unsafe to eat because of the high bacterial content of the meat. Raw or rare poultry also provides a favorable climate for bacteria to grow. Poultry should be cooked to a high enough temperature for a sufficient amount of time to kill potentially harmful bacteria.

Legumes

Legumes are the seeds and pods of leguminous vegetables. The term legume includes dried legumes, lima beans, peas, and string beans. Legumes can be purchased dried, canned, and frozen.

Dried legumes are dried seeds and pods of leguminous vegetables including black beans, black-eyed peas, garbanzo beans, kidney beans, lentils, lima beans, navy beans, peanuts, pinto beans, and soybeans. Dried beans and peas are graded U.S. #1, #2, and #3 with U.S. #1 being the best quality. Products graded U.S. #1 are free of foreign objects such as sticks, stones, and dirt.

Dried legumes require soaking before cooking to rehydrate and soften the beans. Dried legumes may be soaked in cold water overnight or boiled for two minutes and allowed to soak for one hour. They may not soften as completely in hard water as they do in soft water. To improve the softening abilities of the legumes in hard water, one-fourth teaspoon of baking soda can be added to one quart of water at the beginning of the soaking period. The soda breaks down the structure of the legumes. Too much baking soda will result in soft, mushy beans and loss of thiamin and riboflavin. The beans will continue to soften during the cooking process.

Some legumes, called hard shell, will not soften regardless of the softness of the water. Environmental factors and/or storage factors cause the cover of the seed to become less porous, thus limiting the amount of water that can be absorbed. The less water absorbed, the harder the legume.

Dried legumes should be placed in airtight containers and stored in a cool, dry place. These storage techniques help to prevent infestation by insects, fermentation, and growth of molds. If stored properly, dried legumes will keep their quality for several months.

The nutritive value of dried legumes is enhanced through the cooking process. The protein quality is improved while other potentially harmful substances are destroyed. To ensure the maximum nutrient retention, legumes should be cooked in the liquid in which they were soaked.

Lima beans are a common table vegetable. They also are used in casseroles and soups. The Fordhook and the dwarf lima bean are the two most common types.

Peas are round and grow in a shiny green pod. The ***field pea*** is round and smooth. The ***garden pea*** is round, wrinkled, and has a sweet flavor due to its high sucrose (sugar) content. Immediately after harvesting, the sucrose content begins to decrease while the starch content increases. Poor quality peas typically have a higher starch content than sucrose content. If peas are stored for long periods of time, the starch content will be high, negatively affecting the quality, flavor, and texture of the pea.

The sugar snap pea and the Chinese snow pea are both eaten with their pod. Either can be eaten raw or cooked. If cooked, they should be cooked quickly to retain crispness.

String beans are long and thin with small, immature beans within the pod. They can be purchased in broken pieces, cut pieces, whole, or French style, which is the most expensive.

The cut has no impact on the flavor or the nutritional value of the bean. It only affects how the bean looks.

Cheese

Cheeses must be selected for their intended use. Some cheeses are used mostly for appetizers, desserts, and salads. These cheeses include the following:
- brie
- Camembert
- Edam
- Gorgonzola
- Gouda
- Liederkranz
- Limburger
- Roquefort
- Stilton

Some of these cheeses have very strong flavors that make them unsuitable for cooking. Others do not melt and blend during cooking.

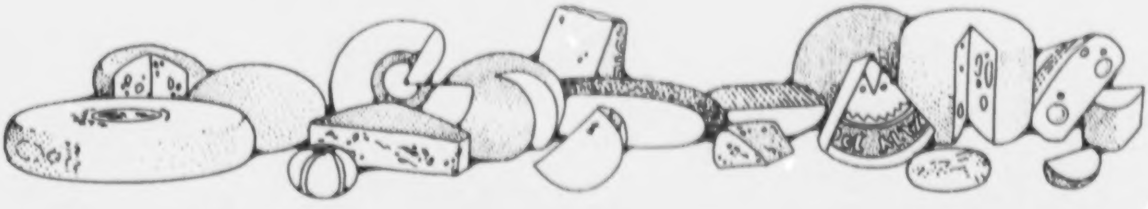
A good cheese for cooking should be meltable, blendable, and have a definite cheese flavor. When heated, the cheese should become soft and smooth; it should blend easily with other ingredients. The texture should be appropriate for the item being prepared. The flavor should be definite but not so strong that it overpowers the flavor of other ingredients.

Common cheeses used in cooking include the following:
- American
- Cheddar
- Colby
- cottage cheese
- cream cheese
- Monterey Jack
- mozzarella
- ricotta
- Swiss

American, Cheddar, Colby, mozzarella, and Monterey Jack cheeses may be purchased in blocks, bricks, loaves, moons, half-moons, rolls, links, or they may be sliced, grated, shredded, or cubed. Other processed cheeses may be purchased in a variety of flavors in pressurized cans, such as spreads and dips, or as balls rolled in nuts. Cheese spreads are packed in jars. Convenience forms of cheese usually cost more than the same weight of cheese in a solid piece.

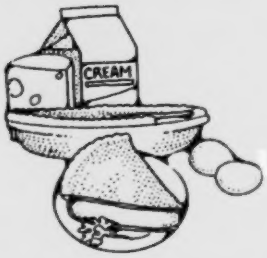
Soft cheeses such as cottage cheese, ricotta, and cream cheese are highly perishable. They must be used before the date marked on the package. Cottage cheese comes in several different varieties. It can be purchased as dry cottage cheese with no cream added or as creamed cottage cheese. It also may be purchased with added fruits, fresh garden vegetables, or chives.

Canned cheese soup or cheese sauces are also available. Canned cheese soup may be used as a sauce for au gratin vegetables, casseroles, meats, and pasta. In addition to products that are primarily cheese, a variety of convenience foods containing cheese are available. An example is macaroni and cheese mix.



Cheese Cookery. Cheese protein, like egg protein, coagulates when heated and becomes tough and rubbery when overcooked. Cheese should be cooked at a low temperature for a short time. When added to other ingredients, it should be cut into small pieces, shredded, grated, or sliced so that it will melt quickly and blend with other foods. High temperatures and overcooking cause cheese to become tough and stringy and may cause the fat to separate and drain from the cheese.

For best results, cheese should be cooked in a double boiler over simmering water or baked in an oven at a low temperature (325°F to 350°F). When cooking cheese over direct heat, use a low temperature and stir constantly to prevent scorching. When cooking cheese or cheese dishes, it is best to heat the mixture just long enough to melt the cheese. This prevents the protein in the cheese from overcoagulating and becoming tough and stringy.



Cheese used as an ingredient in a recipe should be added to the dry ingredients first. When making cheese sauce, the cheese should be added after the white sauce is completely cooked and heated only long enough to melt the cheese. Some cheese dishes, like egg dishes, cannot be stored and reheated successfully. They should be served immediately.

Microwave Cooking of Cheese. Cheese cooks quickly in the microwave oven due to its high fat content. It should receive special attention when cooked in this manner. It only takes a few seconds for the cheese to go from being properly melted to overcooked, tough, and rubbery. Low power and a short cooking time should be used when cooking cheese alone. Cheese used as an ingredient in other products can be cooked at higher temperatures and for longer periods of time.

Milk

Milk, like other animal protein, is sensitive to heat and should be cooked with as low a temperature as necessary for the shortest amount of time. When milk is overcooked, one or more of the following may occur:

- milk film
- boil over
- scorching
- curdling

Milk film forms on the bottom and sides of the pan. This film is caused by overheating of the milk proteins. The film can be prevented by using a double boiler, by using a covered container, by adding butter, and by stirring the milk constantly during the heating process.

When the milk film forms on the top of the heated milk, it forms a tight, steamproof cover. The milk will foam and eventually boil over unless precautions are taken. Scorching can occur if the milk is heated at too high a temperature for too long a period of time. Scorching can be prevented by cooking the milk at low temperatures and stirring during cooking.

Milk will curdle when heated if acid is added to it or when acid-producing bacteria attack the milk. The acid causes the milk proteins to separate and curdle. Vegetable acids in soups, such as tomato soup, may also cause the separation of milk proteins. Lemon juice in cream sauces for seafood may produce the same reaction. To reduce the possibility of curdling, acidic juices should be added after the milk has been cooked and prior to serving.

FACTORS AFFECTING FRUIT AND VEGETABLE COOKERY

Fruits and vegetables are excellent sources of vitamins. Vegetables are grouped according to the part of the plant from which they come, such as the roots, leaves, stems, flowers, fruits, seeds, and tubers. Fruits are seed-bearing plants used for food. Varieties are grouped as pomes (apples and pears), drupes (cherries), berries (grapes), citrus fruits, melons, and tropical fruits.

Vitamins help regulate body functions, growth, and development. Since fruits and vegetables provide many vitamins, their consumption by humans is important. Some vitamins are water-soluble and some are fat-soluble. Table 18.2 lists vitamins and their sources.

The goal when cooking fruits and vegetables is to retain the maximum amount of the original food value, color, flavor, and texture. This goal applies to all forms of vegetables and fruits—fresh, frozen, canned, and dehydrated.

Cooking Principles

Cooking softens the cellulose or structure of fruits and vegetables, making them less crisp. The starch in the fruit or vegetables absorbs water, swells, and becomes more soluble. Changes in color and flavor occur and nutrients dissolve in the cooking liquid. To retain the best qualities, fresh vegetables and fruits should be cooked in as little liquid as possible for as short a time as possible.

The effects of moist heat on the cellulose of fruit is reduced by sugar. When fruits are cooked in moist heat, the fruit breaks apart. When fruit is cooked in sugar or sugar syrup, it retains its shape. The sugar strengthens the cellulose structure and keeps the fruit from falling apart. The decision to add sugar before or after cooking fruit should be based on the desired texture of the cooked fruit product.

Methods of Cooking Fruits and Vegetables

Fruits and vegetables may be boiled, steamed, baked, sautéed, fried, or broiled. They also may be cooked in a microwave oven. Canned vegetables and fruits are completely cooked in the canning process. They may be reheated in their own juices for maximum nutrient retention or used as ingredients.

Dried and dehydrated vegetables and fruits must be rehydrated or reconstituted with water. Dried vegetables may need to be soaked in water, then boiled. Dehydrated vegetables may be reconstituted with water before cooking, or they may be added to dishes high in liquid such as soups. Dried and dehydrated vegetables can be boiled, simmered in water, or baked.

The following are recommended methods of cooking various fruits and vegetables:

- Boiling is the most popular method for cooking fresh vegetables. It can be used for fresh, frozen, canned, dried, or dehydrated vegetables and fruits.
- Steaming is fast, retains nutrients, and preserves the color of the vegetables.
- Vegetables and fruits may be baked whole or in pieces. Canned, dried, frozen, or fresh fruits can be combined with other ingredients to make a variety of dishes.

Vitamin Letter/Number	Vitamin Name	Vitamin Function	Sources of Vitamin
Fat-soluble Vitamins			
A	Retinol	Forms and maintains healthy skin, hair, and mucous membranes; necessary for development of bones and teeth; aids vision in dim light	Yellow vegetables, dark green vegetables, liver, fish, eggs, cheese, whole milk
D	Calciferol	Allows absorption of calcium and phosphorus	Sunlight, butter, cream, fortified milk, fish liver oils
E	Alpha Tocopherol	Prevents breakdown of body tissue; protects vitamin A and essential fatty acids	Green leafy vegetables, wheat germ, beef, fish, liver, chicken, almonds, filberts
K	Phylloquinone	Promotes blood clotting; is required for synthesis of prothrombin	Dark green leafy vegetables, broccoli, cabbage, lettuce, whole grain, cheese, liver
Water-soluble Vitamins			
B1	Thiamin	Helps release energy from carbohydrates; aids in the normal functioning of the nervous system	Enriched whole grain cereals, pork and other meats, fish, legumes, peas
B2	Riboflavin	Helps release energy from protein, fat, and carbohydrates	Dark green leafy vegetables, liver, milk, cheese, lean meat, legumes, eggs, whole grains, enriched cereals, ice cream
B3	Niacin	Helps release energy from protein, fat, and carbohydrates	Liver, lean meats, whole grains, nuts, legumes, cheese, enriched cereals
N/A	Folate	Helps form red blood cells and genetic material in cells	Dark green leafy vegetables, whole grains, liver, eggs
N/A	Biotin	Necessary to maintain normal body functions	Banana, grapefruit, watermelon, strawberries, liver, kidney, egg yolk
N/A	Pantothenic Acid	Helps body metabolize fats, proteins, and carbohydrates	Tomato paste, potatoes, whole grain, liverwurst, poultry
B6	Pyridoxine	Helps body use protein; aids in metabolism of fats	Egg yolk, liver, oatmeal, banana, tomato juice, beef, poultry
B12	Cyanocobalamin	Builds red blood cells and genetic material; metabolizes protein and fat; aids function of nervous system	Beef steak; beef, pork, or poultry liver; clams; eggs; milk products
C	Ascorbic Acid	Forms collagen to provide structure to bones, cartilage, muscle, and blood vessels; maintains capillaries and teeth	Fresh fruits, dark green leafy vegetables, cabbage, broccoli, beef or pork liver, clams

Table 18.2

- Sautéing is cooking vegetables and fruits in a small amount of butter, margarine, or oil.
- Deep-fat frying is submerging food in hot fat. French fried or deep-fried potatoes are popular. Other vegetables like onions, eggplant, cauliflower, broccoli, and squash may be dipped in batter and fried in deep fat. Batter mixed with pieces of vegetables or fruit and fried in deep fat is called a fritter. Corn fritters and apple fritters are among the best known in the United States.
- Broiling is cooking with direct heat under a flame or element. Tomatoes are the most popular broiled vegetable. Broiled grapefruit halves also are popular broiled fruits.

Other guidelines to follow when cooking vegetables include the following:

- Green vegetables should be removed from heat before they turn a brown-khaki color.
- White vegetables turn gray when they have been overcooked.
- Yellow vegetables should be removed from heat before the vegetables lose their yellow color.
- Add lemon juice or vinegar to the cooking liquid of red vegetables to help retain their color especially in hard water areas.

Vegetables should be served immediately after they are cooked. Several vegetables can be combined to make a colorful dish. Some popular combinations include green beans and mushrooms, carrots and celery, cauliflower and peas, potatoes and green beans, and peas and pearl onions. Fruits may be garnished with whipped cream, ice cream, a dessert sauce, chopped nuts, or shaved chocolate.

Fruits cook very quickly in the microwave oven due to their high sugar and moisture content. Fresh fruit should be cooked in uniform sizes whether whole or cut. Fruit sauces should be covered to help retain moisture. Fruit dishes with crust should be left uncovered to prevent the crust from becoming soggy. Vegetables cooked in the microwave oven should be cooked with a smaller amount of water than that used with conventional cooking methods. Vegetables canned at home should not be cooked in the microwave oven because the temperatures and length of time are not great enough to kill toxins that might be present.

FACTORS AFFECTING CARBOHYDRATE COOKERY

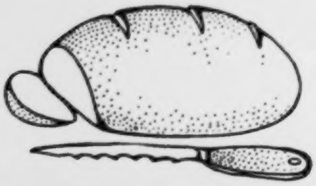
Starch is a complex form of carbohydrate. Carbohydrates are stored in plants as starch. Starch is made up of a combination of many kinds of sugar. Starch is found in bread, cereal, potatoes, pasta, rice, and legumes. During cooking, starch absorbs water and thickens.

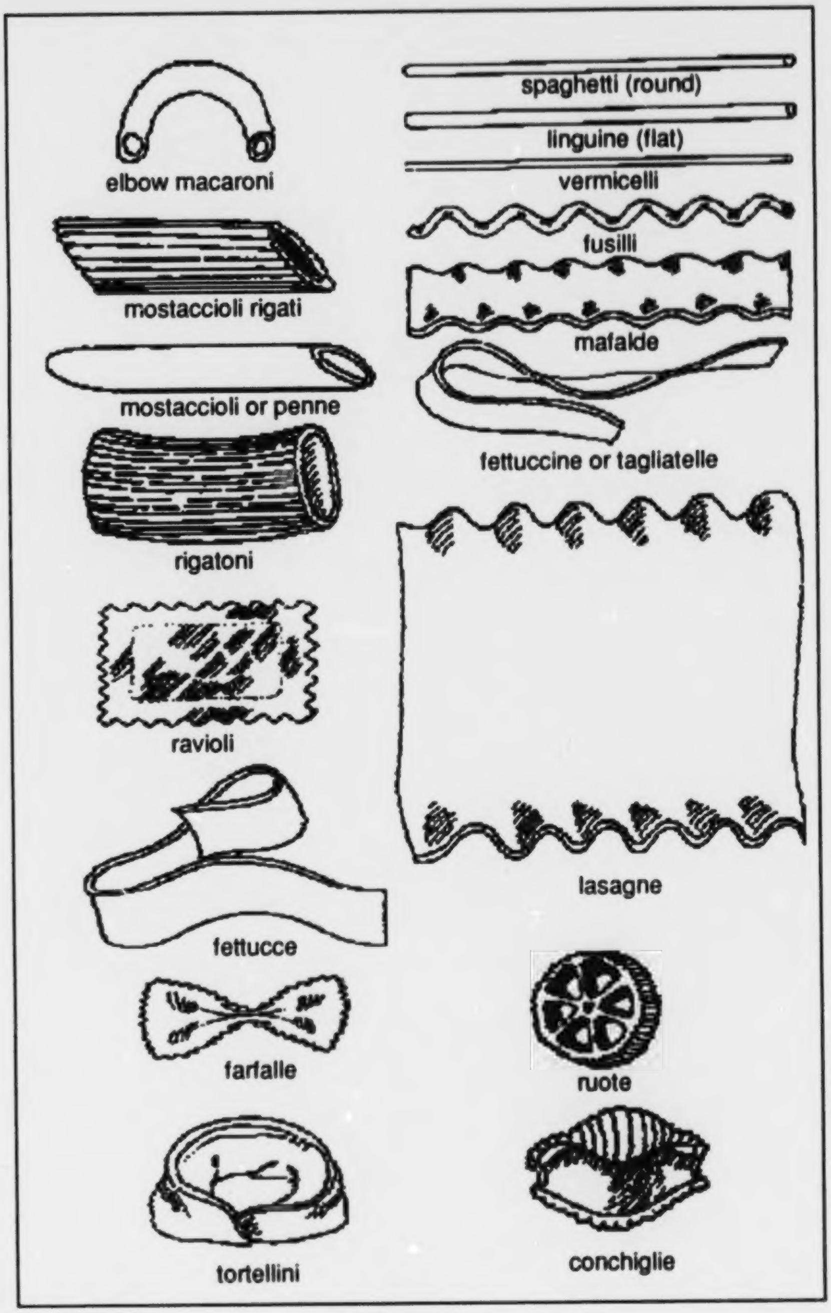
Grains and Pasta

Cereals and pasta are made from grains. ***Grains*** are the edible seeds produced by certain plants of the grass family. The principle grains are wheat, rice, oats, barley, rye, corn, and buckwheat. These grains also are referred to as cereal grains or cereals. Breakfast cereals, pasta (macaroni products), and flour are all made from cereal grains. Grains and grain products are inexpensive food sources that supply body energy. Grain products may be served at any meal. They make interesting and nutritious additions to any part of a meal. They are easy to store and keep well.

With the exception of corn or maize, which is native to North and South America, all true cereal grains originated in Europe and Asia. Buckwheat is native to central Asia.

Pasta is ground grain food products including macaroni and noodle products. ***Macaroni*** products are made from a particular type of flour from durum wheat. The durum wheat has a very high proportion of gluten. When mixed with water, the gluten becomes very elastic, making it easy to stretch and cut into interesting shapes.




elbow macaroni
spaghetti (round)
linguine (flat)
vermicelli
fusilli
mostaccioli rigati
mafalde
mostaccioli or penne
fettuccine or tagliatelle
rigatoni
ravioli
lasagne
fettucce
farfalle
ruote
tortellini
conchiglie

Types of Pasta

- tubes include macaroni and rigatoni
- rods include spaghetti and vermicelli
- ribbonlike strips include lasagne and fettuccine
- special shapes include conchiglie, ruote, and farfalle

Figure 18.4

A variety of pasta products are available. Types of pasta include spaghetti, macaroni, lasagna, ravioli, and spirals. Pasta comes in four main shapes: tubes, rods, ribbonlike strips, and special shapes. Examples of the four main shapes are included in figure 18.4.

Noodles differ from macaroni in that they are made from flour, water, and eggs. The eggs add flavor and tenderness to the pasta. The flour does not need to be a high protein durum flour because of the added egg.

Grain and Pasta Cookery. The cooking principles of starch apply to the preparation of both cereals and pasta. Starch is composed of microscopic granules that absorb liquid and swell when cooked. To prevent lumping of cereal granules, pasta and grain must be added slowly to rapidly boiling water while stirring or mixed with a small amount of cold water before they are stirred into boiling water. Whole cereal grains and pasta are larger pieces than cereal granules. They are added directly to boiling water and stirred briefly to separate.

As the product is heated, the following three things happen:

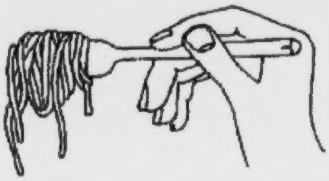
1. The starch absorbs water.
2. The heat of cooking causes the steam to form, which erupts the starch granules.
3. The released soluble starch causes the product to gelatinize.

Gelatinization refers to the thickening or soft gel that forms when starches are cooked. This makes cooked cereals thicken. It makes rice or macaroni products become tender and easy to chew without breaking apart.

Breakfast cereals usually are served at the morning meal. Some are served hot while others are served cold. Cereals also may be used as toppings on casseroles or may be rolled into crumbs and used for breading meats, poultry, and fish. They also are used as ingredients in cookies, quick breads, and special desserts.

Rice is most often served as an accompaniment to meat, poultry, or fish and is occasionally served hot as a breakfast cereal. It may be one of the main ingredients in baked dishes and is frequently an ingredient in soups. Rice is also used in desserts.

Pasta can be used as a main dish like macaroni and cheese or chicken and noodles. Spaghetti or noodles can be used in addition to a main dish instead of a potato. Pasta also can be used as an ingredient in a main dish, soup, or salad.



Pasta and cereals may be boiled or steamed. The amount of water or liquid needed for cooking varies with different pasta and cereal products. The amount of water required is usually two to two and one-half times that of the cereal product. Precooked cereals, such as instant oatmeal, may take less water, so it is best to follow the directions on the package.

At least three times as much water as pasta is necessary to give the pasta room to expand and cook without sticking to the pot. As a rule, granular cereals absorb more water than whole or flaked cereals. When too much water is used, dissolved nutrients are discarded with the excess water. The practice of rinsing whole grain cereals and pasta such as rice and spaghetti may prevent sticking of the cooked product, but it also rinses away some of the water-soluble nutrients. Adding oil to the cookery water may help prevent pasta products from sticking together but also will cause the pasta sauce to slide off the pasta.

The amount of time required to cook cereals and pasta also varies. Fine-grained cereals like cornmeal cook faster than coarser ones like oatmeal. Small or thin pieces of pasta cook faster than large thick ones. Some cereals have been pretreated to cook faster. Smaller pieces cook faster because more of their surface is exposed to the heat and liquid. Cereals with little bran or cellulose cook faster than ones with large amounts. Whole-grain products require longer cooking time to soften the cellulose or fiber.

Cereals and pasta should not be overcooked or overstirred. Overcooking causes the product to become mushy, gummy, or thin. Cereals should be cooked until soft. Pasta should be cooked until tender but firm. Excessive stirring during cooking causes the product to become sticky. Stirring breaks the grains or pieces of the product and increases the amount of starch in the cooking water.

Microwave Cooking. No time is saved by cooking pasta in a microwave oven. Cooking pasta in the microwave oven should be avoided unless the pasta is cooked alone. If pasta is combined with other products, it is best to use the conventional method of cooking. When pasta is combined with another food and cooked in the microwave oven, the other food will usually cook much faster than the pasta, resulting in undercooked pasta and overcooked meat or other ingredients.

Starch as a Thickener. Starches used as thickeners in the preparation of foods include potato starch, cornstarch, tapioca, flour, and arrowroot. Starch granules contain a mixture of amylose and amylopectin. Amylopectin and amylose are starches and chains of glucose or sugar molecules. The proportion of amylose and amylopectin in the starch granules determines the differences in cooking characteristics of the various starches. A high proportion of amylose allows the starch molecules to gel. A high proportion of amylopectin does not allow the starch granules to gel.

Flour or wheat starch is the most commonly used starch in food preparation. In addition to the wheat starch, the flour also contains fats, protein, fiber, vitamins, minerals, and pigments, which cause the flour to form a translucent paste. It is used most often to thicken gravies, soups, and sauces.

Potato starch also forms a translucent paste that is stringy and cohesive. The potato starch paste gels when cooled. It is used primarily in European puddings and matzo bread.

Cornstarch is available in two types known as regular and waxy. The regular type of cornstarch is that commonly sold in grocery stores. It is high in amylose and forms a gel. Regular cornstarch is used in puddings and often in fruit juices. The waxy type contains a high proportion of amylopectin and does not gel. It is used primarily for commercial food production for canning and freezing.

Tapioca is from the root of the manioc plant, a tuberous root plant found in South America and Florida. The roots of the plant must be ground to remove the starch. The starch is processed in a manner that forms the starch into small pellets called pearls which are later dried. These pearls give the tapioca its characteristic texture. Pearl tapioca must be soaked and cooked for long periods of time. Quick tapioca is gelatinized during the manufacturing process and requires less time to prepare. The starch paste formed is translucent and very stringy.

The arrowroot plant of the West Indies is the source of arrowroot starch. Its characteristics are similar to those of potato starch. Arrowroot is good for use in fruit sauces because it leaves the sauce clear. Arrowroot starch will not brown, making it unsatisfactory in brown sauces or gravies. Arrowroot starch is used more often in Europe than in the United States.

Modified starches are starches that have been chemically or physically modified to make them suitable for use in the food industry. Pregelatinized or modified starches have been precooked, gelatinized, and dried. Water and sometimes water and heat are added to the starch to rehydrate it. Modified starches are used primarily in the food industry in convenience foods high in starch. Examples of convenience foods high in starch include instant mashed potatoes and instant puddings.

Baked Goods

To produce quality baked goods, one must have adequate ingredients for structure, liquid, a binding agent, a leavening agent, fat, and flavor. Ingredients most commonly used include the following:
- flour to provide structure
- milk or water for liquid
- eggs as a binding agent
- liquid, baking soda, baking powder, or air as a leavening agent
- butter, margarine, shortening, or lard as fat
- sugar, honey, molasses, or corn syrup for flavor

For more information on ingredients of bakery products, refer to Chapter Seventeen.

Baked goods are baked with dry heat. The oven temperature used must be exactly the temperature specified in the recipe. The baking process occurs when the heat from the oven causes the moisture in the product to steam and evaporate. The surface becomes dry and forms a crust. As the temperature of the product continues to rise, browning occurs on the outside of the product first and then continues to the center of the product. Using an oven that is too hot results in a surface that dries and hardens before the product has been allowed to rise sufficiently. The surface continues to brown as the inside cooks. The result is a scorched crust.

An oven that is not hot enough results in a product that is not done. The batter or dough may dry out before it can brown. When the gluten is not cooked long enough to hold in the gas bubbles produced by the leavening agent, the product collapses. An oven that heats unevenly produces a bakery product that is cooked unevenly.

The pan or utensil that the product is baked in also is important. The size of the pan as well as its condition affect the final product. A utensil that is too small may result in the batter or dough overflowing the pan as it rises. A utensil that is too large results in a product that is flat and dry.

Most cooking utensils used with baked goods must be greased before the batter or dough is added. Some nonstick surfaces do not need to be greased. Greasing the utensil helps keep the product from sticking to it. The product used to grease the utensil can be one of the following:
- oil
- shortening
- nonstick spray
- unsalted solid fat

Some recipes may call for both grease and flour to coat the baking utensil. If any part of the product sticks to the pan, it endangers breaking up the whole product.

Angel food cakes or sponge cakes require a special pan. These pans should not be greased. The high egg white content in the cakes forms a delicate structure that must attach itself slightly to the thin sides of the pan. The grease would cause the pan to be slippery. The slippery side would cause the product to fall or collapse.

The oven door should not be opened during the cooking process. Each time the door is opened, the oven temperature is lowered. The cool air can cause the product to collapse.

The product should be removed from the pan according to the instructions on the recipe. Most products need to be removed immediately to prevent sticking. Some products may need to be allowed to cool slightly in the pan before they are removed. Exceptions include cakes without shortening (angel food and sponge cakes), quick breads, and some cookies.

Microwave ovens are primarily recommended for reheating bakery products rather than for cooking them. Quick breads can be cooked in a microwave oven, but the result will be a more compact product that does not brown on top. Yeast breads do not cook well in a microwave oven.

Pies and Pastries. Pies and pastries can be homemade or purchased frozen or premixed. Most of the frozen and premixed pies and pastries available today are of acceptable quality.

The basis of a pie or pastry is its crust. The crust is made from four basic ingredients:
- flour
- fat
- salt
- cool water

A crust can be made richer by using eggs and sugar.

The fat used in the crust is the most significant factor in producing a quality crust. Butter, lard, margarine, and oil can be used as the fat ingredient in a crust. Each type of fat results in a product with a different flavor, flakiness, and tenderness. Figure 18.5 identifies the characteristic of each type of fat or shortening.

Types of Crusts

- Butter produces a weak, crisp crust with good flavor.
- Lard or hydrogenated shortening produces a strong, flaky crust with good flavor.
- Margarine produces a weak, crumbly crust with good flavor.
- Oil produces a weak , grainy crust; flavor can vary.

Figure 18.5

Summary

- Protein foods include eggs, meat, fish, poultry, legumes, cheese, and milk.
- Eggs may be purchased fresh, frozen, and dried. Whole eggs, whites, and yolks may be processed in liquid, frozen, and dried forms.
- When eggs are used as ingredients in a recipe, they contribute nutritive value; color; flavor; texture; and leavening, emulsifying, and binding capabilities. They also provide a coating for foods that are fried.
- The cuts of meat can be classified into three groups—tender cuts, less tender cuts, and variety meats.
- Variety meats are more perishable than other meats and should be cooked soon after purchase.
- The method for cooking fish depends on the type of fish being cooked, whether the fish is frozen or fresh, the amount of fat in the fish, and the preparation needed before cooking.
- Both finfish and shellfish have a high moisture content that makes them good candidates for microwave cooking.
- Poultry is the term used for domestic birds raised for food. The most commonly used types of poultry are chicken and turkey.
- Dried legumes are dried seeds and pods of leguminous vegetables including black beans, black-eyed peas, garbanzo beans, kidney beans, lentils, lima beans, navy beans, peanuts, pinto beans, and soybeans.
- Cheese protein, like egg protein, coagulates when heated and becomes tough and rubbery when overcooked. Cheese should be cooked at a low temperature for a short time.
- Milk, like other animal protein, is sensitive to heat and should be cooked with as low a temperature as necessary for the shortest amount of time.
- The goal when cooking fruits and vegetables is to retain the maximum amount of their original food value, color, flavor, and texture.
- Grains are the edible seeds produced by certain plants of the grass family. Cereal and pasta are made from grains. The principle grains are wheat, rice, oats, barley, rye, corn, and buckwheat.
- Starches used as thickeners in the preparation of foods include potato starch, cornstarch, tapioca, flour, and arrowroot.

- Modified starches are those that have been chemically or physically modified to make them suitable for use in the food industry.
- The basis of a pie or pastry is its crust, which is made from flour, fat, salt, and cool water. A richer crust can be made by using eggs and sugar.

Vocabulary

albumen
beef
bloom
bone
broiler
butterfly
candling
capon
chalaza
complete egg substitute
connective tissue
cornstarch
dressed fish
dressed poultry
dried eggs
dried legumes
field pea
fillets
fish steaks
fortified eggs
fresh eggs
frozen eggs
fryer
garden pea
gelatinization
grains
grinding
hen
lamb
legumes
less tender cuts
lima beans
macaroni
marbling
modified starches
muscle
mutton
noodles
papain
partial egg substitute
pasta
poaching
pork
potato starch
poultry
pounding
roaster
roaster hens
roaster toms
scoring
starch
stewing hens
string beans
tapioca
tender cuts
variety meats
veal
whole fish
yolk

Review

1. What is involved in the candling process?
2. Why did food technologists develop egg substitutes? How do complete egg substitutes differ from partial egg substitutes?
3. What contributions do eggs make when used as ingredients in various recipes?
4. Why should cheese be cooked at a low temperature for a short time?
5. What can happen to milk if it is overcooked?
6. What are the principles of starch cookery?
7. How do macaroni and noodles differ?
8. What principles should be observed when cooking fruits and vegetables?
9. How are meats tenderized?
10. What are the four basic cooking stages of meat and their characteristics?
11. Why should pork be cooked to the well-done stage?
12. What are four reasons for cooking meat?
13. How do the methods of cooking fat fish and lean fish differ?
14. How should older, mature chickens be cooked?
15. What type of heat should be used with bakery products?
16. List the vitamin names, letters/numbers, functions, and sources of two fat-soluble vitamins and three water-soluble vitamins.
17. What is the most significant factor in producing a quality pie crust or pastry?
18. Describe the difference between finfish and shellfish. How do their methods of cookery differ?

Critical Thinking

Assume you are the manager of a large cafeteria. Serving time for lunch begins at eleven o'clock. A few workers could not come to work so those that are there must work as fast as as they can. Ten meat dishes must be prepared, fifteen vegetable dishes, plus various salads, breads, and desserts. Once cooked, they must be stored in warmers or coolers until needed. The cafeteria operates a continuous serving line until eight o'clock in the evening. Some foods may be kept in the warmer for six or seven hours. What may happen to the quality of the food if it stays in a warmer for a long period of time after it is cooked? How important do you think the nutritional value of the food is to the manager compared to the preparation schedules and profits?

Now assume that you are the consumer and have decided to eat at the cafeteria. What obligation does the cafereria manager have to the consumer? How important is the nutritional value of the food to the consumer compared to the manager's perception of the importance of the nutritional value of the food?

19

Fat Absorption in Food Preparation

ESSENTIAL ELEMENT

- ☐ Analyze factors which affect fat absorption when frying foods.(j3H)

OBJECTIVES

- ☐ Compare the three classifications of fats.
- ☐ Distinguish between the primary fats used in food preparation and their characteristics.
- ☐ Recall measures that reduce the absorption of fat when frying foods.

Fats and oils are the same substance—fat. Fats that are solid at room temperature are typically called ***fats***. Fats that are liquid at room temperature are generally called ***oils***. Fats and fatlike substances also are known as ***lipids***.

Fats are used for various reasons in food preparation. Fats can be found naturally in various foods. Cheese and milk contain butter fat. Nuts, meat, poultry, and fish contain fats as well. Fats also can be used in their pure form, such as cooking oils, for food preparation. Uses of fat include adding flavor or enhancing the flavor of other ingredients, keeping foods from sticking to each other and food utensils, tenderizing baked products, and providing a cooking medium for frying foods.

Fats used in food preparation come from two sources: plants and animals. Examples of fats from plants include the following:

- canola oil
- corn oil
- cottonseed oil
- olive oil
- peanut oil
- safflower oil
- sunflower oil
- tropical oils (coconut oil, palm kernel oil, and palm oil)

Fats from animal sources are as follows:

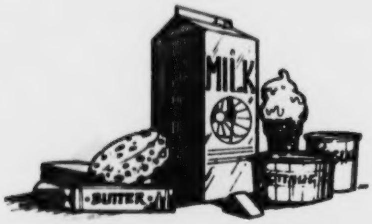
- butter
- hydrogenated animal shortening
- lard

CLASSIFICATIONS OF FATS

Fats are classified as saturated, monounsaturated, or polyunsaturated. Fats in food are from one of these categories or a combination of the categories. The terms saturated, monounsaturated, and polyunsaturated refer to the amount of hydrogen in the chainlike chemical structure of fat. Saturated fats have the most hydrogen. Monounsaturated fats have less hydrogen, and polyunsaturated fats have the least amount of hydrogen. These differences affect the appearance of different fats at room temperature and their taste. The more saturated the fat, the more solid it is.

Saturated Fats

Saturated fats contain as much hydrogen as is possible. Animal fats and tropical oils are the most saturated fats. They may be solid at room temperature. Saturated fats are the tastiest of the fats. Saturated fats are in meats, butter, lard, coconut oil, whole milk, cream, ice cream, and egg yolks as well as in many processed foods such as chocolate and cheeses. Saturated fat is most often used in convenience baking mixes.



Recent studies have shown a tendency for saturated fats to raise blood cholesterol levels. Cholesterol may cause health problems if there is an excess or a high level of it in the bloodstream. For individuals who have high cholesterol levels, it is recommended that they decrease fat intake, especially saturated fats.

Monounsaturated Fats

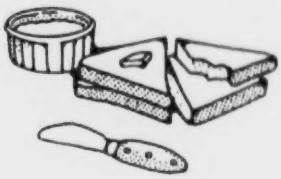
Monounsaturated fats contain less hydrogen than saturated fats but more hydrogen than polyunsaturated fats. They are typically liquid at room temperature. Most vegetable oils have a high percentage of monounsaturated fat. Monounsaturated fats can be found in egg yolks, lard, and vegetable oils.

Polyunsaturated Fats

Polyunsaturated fats are the fats most desirable in a person's diet. Safflower oil contains the highest proportion of polyunsaturated fatty acids. Peanut oil, corn oil, soybean oil, olive oil, and cottonseed oil also contain a high percentage of polyunsaturated fatty acids.

Linoleic acid is a polyunsaturated fatty acid that is essential for growth. Research has shown that it can help reduce the amount of cholesterol in the body and can reduce the risk of circulatory or heart diseases. It is an essential fatty acid because it cannot be produced by the body and must be supplied in the diet. Vegetable oils are the best sources of linoleic acid. Safflower oil is the richest. Corn oil, cottonseed oil, and soybean oil are good sources as well. Coconut oil has more saturated fat so it has less linoleic acid.

Sometimes manufacturers add hydrogen to oil, or hydrogenate it, to make it more solid at room temperature. For example, margarine and vegetable shortenings may be made from hydrogenated polyunsaturated oils. Adding the hydrogen increases the saturated fat. Hydrogenating a polyunsaturated oil transforms it into a monounsaturated or even a saturated fat depending on the degree of hydrogenation.



The approximate percentages of saturated, monounsaturated, and polyunsaturated fat in various fats are listed in table 19.1.

The Composition of Fats			
	Saturated Fat (%)	Monounsaturated Fat (%)	Polyunsaturated Fat (%)
Beef Tallow*	48	42	4
Butter	66	30	4
Lard	41	47	12
Margarine	19	49	32
Canola Oil	6	62	32
Coconut Oil	86	10	4
Corn Oil	13	30	57
Cottonseed Oil	27	19	54
Olive Oil	14	77	9
Palm Oil	50	38	12
Peanut Oil	18	49	33
Safflower Oil	10	13	77
Soybean Oil	15	24	61
Sunflower Oil	11	20	69
Lard and Vegetable Oil Shortening*	37	41	10

Sources: Canola oil: data on file, Procter & Gamble. Others: Adapted from Reeves, J.B. and Weihrauch, J.L. "Fats and Oils. Raw-Processed-Prepared," *Composition of Foods, Agriculture Handbook No. 8-4*, Washington, D.C.: United States Department of Agriculture, 1979.

* Numbers do not add up to 100 percent because other minor fat compounds are present.

Table 19.1

FATS USED IN FOOD PREPARATION

The types of fat used most often in food preparation are lard, butter, corn oil, olive oil, hydrogenated shortening, and margarine. All fats used in food preparation taste and feel greasy. They absorb strong odors and flavors from foods around them. They also become rancid when exposed to air.

Lard

Lard refers to the fat made from hogs. The composition and general characteristics of lard vary depending on the type of food the hog has eaten. Hogs that have been fed soybeans or peanuts produce a softer lard than those that have be fed corn. The part of the hog from which the lard is obtained also affects its composition and characteristics. The firmest fat comes from the fat covering the internal organs.

Lard is approximately 40 percent monounsaturated fat. It is relatively soft at room temperature yet firm when stored in the refrigerator. Lard is bland in flavor. It is often preferred as the fat ingredient for pastries because of the strong crust, good flavor, and flaky crust it produces when mixed with the other ingredients.

Butter

Butter is a very saturated fat made from cream. It is composed primarily of both saturated and monounsaturated fatty acids. Butter must have a minimum of 80 percent fat as regulated by the Food and Drug Administration. Approximately 40 percent of the fat is monounsaturated. Eighteen percent of butter is water. Butter is a good source of vitamin A. Other ingredients in butter include milk solids and usually color and flavoring. Butter absorbs odors very easily and should be stored tightly covered in the refrigerator.

Butter can be purchased with or without salt. Most butter is salted unless it is labeled sweet butter. ***Sweet butter*** is not salted. Unsalted butter is typically more perishable than salted butter; salt is added as a preservative.

Oils

Oils refer to fats that stay liquid at room temperature and when refrigerated. Vegetable oils are often referred to as salad oils. They are almost 100 percent fat. The majority of oils come from plant seed while some come from the fruit of the plant. Coconut oil and olive oil come from the fruit of the coconut and olive plants. Soybean oil is typically the primary oil in products labeled ***vegetable oil***. Other oils used in products labeled vegetable oil include, but are not limited to, the following:

- canola oil from rape seed found primarily in Canada
- corn from the germ of the corn grain
- peanut oil from peanuts
- soybean oil from soybeans

Oils, like other fats, make foods tasty, crisp, and tender. Oils have little flavor of their own, with the exception of olive oil. Olive oil has a distinctive flavor that is used often in salad dressings. Oils bring out flavors in herbs and spices, making them good for baking. Oils are good for frying or sautéing meats, poultry, and fish. Oils are preferred as the fat used to brush meats, poultry, and fish when baking or broiling.

As with other fats, oils absorb strong flavors and odors from foods around them. They also become rancid when exposed to air. The possibility of rancidity in oils is decreased when the oils are packaged in dark containers that protect them from light. Oils differ from other fats in the following ways:

- ***congealing point*** (temperature at which fat solidifies)
- ***flavor*** (taste)
- ***melting point*** (temperature at which a solid becomes a liquid)
- ***rate of rancidity*** (rate of deterioration)
- ***smoke point*** (temperature fat begins to burn or smoke)

Coconut oil is a highly saturated oil. It is also inexpensive. It is not uncommon for manufacturers to blend coconut oil with polyunsaturated oils that are more expensive, such as corn oil, olive oil, safflower oil, soybean oil, or cottonseed oil, to lower manufacturing costs. It is important to read labels in order to purchase products with pure corn, safflower, or other polyunsaturated oils. Fast-food establishments often use lard or inexpensive coconut oil for deep-fat frying.

Hydrogenated Fat

Hydrogenation occurs when hydrogen is added to the chemical structure of fat. A polyunsaturated fat can go through the process of hydrogenation and become partially or completely saturated. Hydrogenation increases a product's saturated fat content. Therefore, a product labeled "hydrogenated vegetable oil" contains saturated fat.

Shortening is made through the hydrogenation process. The fat used may be vegetable oil, animal fat, or a combination of the two. Air is whipped into the fat during hydrogenation to produce its creamy appearance. Chemicals also are added. The chemicals added to hydrogenated shortening help prevent oxidation and rancidity. They also increase the volume and moistness of the shortening.

Margarine

Margarine is produced as an alternative for butter. The two are similar in appearance, color, and flavor. Butter has more saturated fat than margarine. Margarine contains a minimum of 80 percent fat. It also contains vitamin A (retinol), as required by the Food and Drug Administration, and it may contain salt, whole milk, and nonfat dry milk. Soybean oil is the most commonly used fat in the production of margarine. Soybean oil is inexpensive and easily available.

Margarine can be purchased in several forms. The most common forms include the following:
- diet
- regular
- soft
- whipped

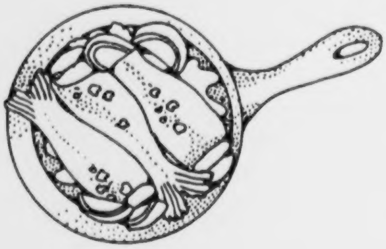
Varying amounts of linoleic acid are found in all margarines. A margarine made from partially hydrogenated polyunsaturated oil or fat is the most desirable. Those made from hydrogenated polyunsaturated oil are the least desirable.

Diet margarines contain less than 80 percent fat. Diet margarines have fewer calories than regular margarines. Approximately 50 percent of the fat in regular margarine is replaced with water in diet margarine.

Labels and advertising claims can be deceiving in regard to product content. A rule of thumb for judging the degree of saturated fat in a margarine is that the firmer the product, the higher the saturated fat content.

FATS AND FRYING FOOD

Fat serves as a heat transfer medium when foods are pan-fried or deep-fried. Pan-frying allows the food to absorb some of the fat flavor while causing a brown crust to develop on the surface of the food. Foods fried in deep-fat have a golden brown crust and are crisp. The heat for deep-fat frying must be hot enough to quickly cook the food. If the temperature of the fat is too high, the food will be overcooked on the outside before the inside has enough time to cook completely. Temperatures that are too high can cause the fat to smoke. Very high temperatures can cause the fat to ignite. Temperatures that are too low increase the cooking time and cause the food to absorb excess fat. This results in a greasy product.



Fat that smokes or turns brown during cooking should be discarded. These are signals that the fat molecule is breaking down. Because salt breaks down fat, it is necessary to season foods after frying. When fat breaks down, it has an unpleasant odor and taste. This unpleasant odor and taste is often referred to as acrid. The acrid flavor that develops ruins the food and the oil. Both should be discarded. Foods cooked in fat at this stage of deterioration can cause irritation to the digestive system if eaten.

Smoke Points

The ***smoke point*** of fats refers to the temperature at which the fat begins to burn or smoke. Fat with a high smoke point should be used for deep-frying. Fried food should have a golden color and a crisp surface when done. This can only be accomplished when the correct type of fat is used at the right temperature. Fat with an acrid or unusual flavor is bad and should not be used for any type of frying.

Different types of fat have different smoke points. Most foods do not require a frying temperature above 390°F. The fat used should have a smoke point that is 30°F higher than the temperature needed to cook a particular food. Vegetable oils have the highest smoke points followed by vegetable and animal shortenings. The smoke point of shortenings is lowered by as much as 100°F when emulsifiers are added. Emulsifiers typically used are monoglycerides and diglycerides. They have the ability to keep the fats suspended in the liquid so that they do not separate. Shortenings, butter, and margarine with emulsifiers have lower smoke points. This makes them more suitable for pan-frying foods. Diet margarines have a high water content, which makes them less suitable even for pan-frying. The water content causes the fat to splatter.

The smoke point of fats can be affected by the way the fat is handled. For example, a fat that has been handled or used repeatedly has a lower smoke point than one that has not been handled or used. The smoke point is also lowered as the amount of food particles dispersed through the fat increases. An egg coating also lowers the smoke point and darkens the color of the fat.

Another factor affecting the smoke point of a particular fat is the type of utensil in which the food is fried. The smoke point of fat used in a wide, shallow pan with sloped sides is lower than the smoke point of the same fat used in a smaller pan with straight, vertical sides.

Butter and margarine have the lowest smoke points of any fat. They are best suited for low-heat sautéing. Butter and margarine should never be used for frying.

Oils and hydrogenated shortenings are quite suitable for use in frying because they have a very high smoking point. Olive oil should not be used in frying because it has a low smoke point. Lard also is suitable for frying foods.

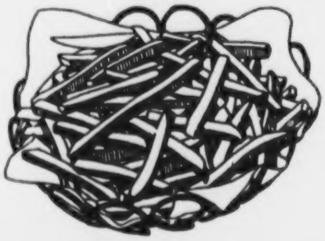
Table 19.2 identifies temperatures to which various fats can be heated for deep-fat frying. The temperatures stated are slightly below the particular fat's smoking point. These fat temperatures are safe for frying foods. A thermometer should be used when deep-fat frying to determine and maintain the correct temperature for the particular fat being used.

Type of Fat	Temperature
Butter	Should not be used for deep-fat frying
Margarine	Should not be used for deep-fat frying
Shortening	350°F
Lard	360°F
Vegetable Oils	440°F

Table 19.2

Absorption of Fat

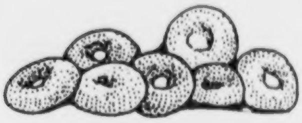
The browning that occurs during the frying process is a result of the temperature of the fat, the amount of time the food is cooked, and the structure of the food rather than the fat alone. The crispness of the crust is a result of the amount of moisture lost due to the heat. The lost moisture is replaced by the fat in which the food is cooked. The fat will tenderize the crust and add moisture and flavor to the food.



The amount of fat absorbed in fried food depends on a variety of factors. Those factors include the following:

- type of ingredient or food product
- temperature of the fat
- surface area of the food

The type of ingredient or food product affects the amount of fat absorbed by the ingredient. The higher the liquid, sugar, and leavening ingredients of a product, the greater the amount of fat absorbed. Due to its ingredients, a doughnut absorbs a greater amount of fat than a piece of chicken.



The temperature of the fat determines the amount of fat absorbed by the food product. The fat used must be heated to the appropriate temperature before the food is immersed. Failure to do so will result in more time needed to cook the food. The prolonged cooking time will make the food soggy and greasy. When cold foods are added to heated fat, the temperature drops. Adequate time must be allowed between cooking batches to allow the fat to heat up to the appropriate temperature. Putting too much food in the heated grease at one time causes the temperature of the grease to drop and prolong the cooking time.

The surface area of the food also influences the amount of fat absorbed during frying. The larger the surface area exposed, generally the more fat that is absorbed.

Cooking Times

Cooking time for frying is affected by the type of food and its size. Table 19.3 represents general temperatures and times recommended for deep-frying various foods.

Times and Temperatures for Frying Foods

Type of Food	Temperature	Minutes
Chicken	325°F to 350°F	10 to 15
Doughnuts	350°F to 375°F	1to 3
Fish	350°F	3 to 6
French Fries	395°F	2
Meat	350°F	3 to 7
Vegetables	350°F to 375°F	3 to 5

Table 19.3

Summary

- ☐ Fats and oils are the same substance.
- ☐ The three classifications of fat are saturated, monounsaturated, and polyunsaturated.
- ☐ The types of fat used most often in food preparation are butter, corn oil, olive oil, hydrogenated shortening, and margarine.
- ☐ Soybean oil may be the primary oil in products labeled "vegetable oil."
- ☐ The smoke point of fats refers to the temperature at which the fat begins to burn or smoke.
- ☐ Cooking times for deep-fat frying are affected by the type of food and its size.

Vocabulary

butter
congealing point
fats
flavor
hydrogenation
lard
linoleic acid
lipids
melting point
monounsaturated fats
oils
polyunsaturated fats
rate of rancidity
saturated fats
smoke point
sweet butter
vegetable oil

Review

1. List some uses of fats.
2. From what two sources do fats come? Identify three from each source.
3. How do saturated, monounsaturated, and polyunsaturated fats differ?
4. What are the benefits of linoleic acid in the diet?
5. Which vegetable oil is highest in saturated fat?

6. How do products labeled "butter" and "sweet butter" differ?

7. In what ways do butter and margarine differ?

8. Which oil has the highest percentage of polyunsaturated fat?

9. What happens to the fat content of polyunsaturated fats when they are hydrogenated?

10. How do margarine and diet margarine differ?

11. What four factors can affect the smoke point of a particular fat?

12. What three factors affect the amount of fat absorbed when foods are deep-fat fried?

Critical Thinking

Research the term "vegetable oil." Compose an accurate definition for consumers. Examine the labels on a variety of vegetable oil containers and identify the type of vegetable oil used. Determine if the products contain primarily saturated or polyunsaturated fat. Compare the cost of the primarily saturated fats with the cost of the polyunsaturated fats. What reasons can you give to justify the cost difference?

Investigate the types of vegetable oils used by local fast-food establishments. Are they primarily saturated or polyunsaturated products? What assumptions are made by consumers as a result of advertising claims about the use of vegetable oils by these restaurants?

20

Making Food Products More Nutritious

ESSENTIAL ELEMENT

- ☐ Determine methods for making food products more nutritious.(j3I)

OBJECTIVES

- ☐ Compare the processes of enrichment, fortification, and restoration.
- ☐ Propose methods for increasing the protein content of various food products.
- ☐ Differentiate between the various types of nutrification of carbohydrate products.
- ☐ Identify the functions and sources of various vitamins and minerals.
- ☐ Discuss the needs and sources of fats in the diet.
- ☐ Describe the functions of water in the diet.

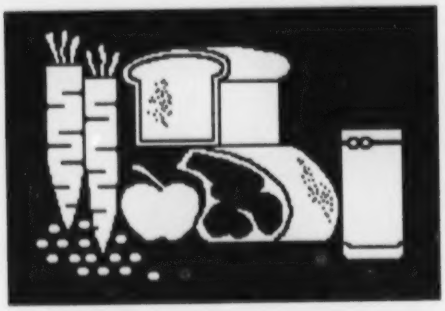
Nutrients are life-sustaining substances that nourish and promote the growth of the human body. The six basic nutrient groups are the following:

- proteins
- carbohydrates
- fats
- vitamins
- minerals
- water

Some nutrients supply energy to the body (proteins, carbohydrates, and fats), but all nutrients help build cells and tissues. Nutrients also regulate body functions such as breathing.

No one food contains all of the nutrients necessary for the body to function effectively; therefore, a balanced diet that incorporates appropriate amounts of the six basic nutrients, as well as appropriate servings from the basic food groups, is necessary. Individuals should choose foods of high nutrient density rather than foods with empty calories. Foods that are ***nutrient dense*** are foods that are excellent sources of essential nutrients with few, if any, empty calories. Foods with ***empty calories*** refer to foods that provide calories or energy but little or no nutritive value.

Figure 20.1 represents the USDA's suggested daily servings from the food groups.



NUTRIFICATION

It is possible to improve the nutritional value of foods through the process of nutrification. ***Nutrification*** refers to the addition of nutrients to foods. When nutrients are added to foods, the concentration of those nutrients increases.

The three basic types of nutrification are enrichment, fortification, and restoration. The process of nutrification began in the 1930s after the discovery of most of the vitamins and their functions. Examples of foods with added nutrients include breakfast bars, enriched flour, margarine, pasteurized milk, nonfat dry milk, infant formula, and table salt.

Enrichment refers to the addition of nutrients that are naturally present in the product. The enrichment increases the amount present. By increasing the amount of the nutrients in the product, the consumption of the nutrient will increase accordingly.

The Basic Food Groups

Meat, Poultry, Fish, and Alternates

(eggs, dry beans and peas, nuts, and seeds)

Servings: 2-3

The meat group or protein group is made up of eggs, peanut butter, and all types of meat including beef, poultry, pork, lamb, and fish.

Fruits

Servings: 2-4

The fruit group is made up of all fruits including, apples, bananas, oranges, grapefruits, melons, and berries.

Vegetables

Servings: 3-5

The vegetable group includes all vegetables including broccoli, spinach, squashes, carrots, and lettuce.

Breads, Cereals, and Other Grain Products

Servings: 6-11 (Include several servings of whole-grain products daily.)

The bread and cereal group includes bread, cereal, rice, and pasta.

Milk, Cheese, and Yogurt

Servings: 2

The milk group includes all types of milk, cheese, and yogurt.

Fats and Sweets

Servings: none

Avoid too many fats and sweets.

Avoid alcoholic beverages.

Source: Adapted from "Preparing Foods and Planning Menus," *Home and Garden Bulletin* No. 232-8, U.S. Department of Agriculture Human Nutrition Information Service, U.S. Government Printing Office: Washington, D.C., p. 11.

Figure 20.1

Enrichment and restoration are often used interchangeably. ***Restoration*** refers to the process of replacing nutrients in a food product that were lost during processing. Riboflavin and thiamin were first restored to white bread in the 1930s. By 1941, legislation was passed requiring the restoration of riboflavin and thiamin to white flour and bread. The fortification of niacin and iron also was required.

Fortification refers to the addition of nutrients that may or may not be found naturally in the product. As with enrichment, fortification increases the consumption of various nutrients. Fortification is intended to correct nutritional deficiencies in special segments of the population.

The nutrification of various foods has changed and improved in recent years. Protein can be added to foods with synthetic amino acids or by adding small quantities of foods rich in protein into foods that are not. For example, milk powder, soy protein concentrate, and yeast preparations can be added to other foods to increase the protein content. There are many other ways that the nutrient content of foods can be increased.

The nutrification of foods became increasingly important after nutritional labeling laws were passed in the early 1970s. New labeling laws passed in 1990 also will have a great impact on nutrification. According to the American Medical Association and the National Academy of Sciences National Research Council, supplements (the process of nutrifying foods or providing additional nutrients in nonfood forms) are considered approved if the following occur:

- low intake of the nutrient or nutrients in a significant proportion of the popuiation exists
- the added nutrient will be stable under proper storage conditions
- the added nutrient will not cause an imbalance in the other nutrients present in the food
- the body can absorb and utilize the added nutrient
- the addition of the nutrient will make a significant contribution to the diet of the population needing it
- the supplement will not increase the intake level of the nutrient to that of toxicity

Nutrification has a number of advantages and disadvantages. Some of the advantages include the following:

- Nutrification does not change the taste, odor, or appearance of the food product.
- Fortification provides an easier way to remove nutrient deficiencies.
- All segments of the population can be reached.
- No changes are necessary in preparation or eating habits of food products.
- Nutrification is relatively inexpensive.

Disadvantages of nutrification include the following:

- Only those that eat the nutrified foods benefit from nutrification.
- Nutrification adds to the cost of the product.
- Some people avoid foods with any type of additive—good or bad.
- A certain amount of waste occurs with nutrification because some products may be nutrified to incorporate 100 percent of the Recommended Daily Allowance (RDA) of a nutrient. There are no regulations. The Food and Drug Administration (FDA) classifies a food as a drug if the amount of a particular nutrient exceeds 150 percent of the RDA.

PROTEINS

Proteins are needed for growing and forming new tissue; maintaining and repairing tissue; forming enzymes, hormones, and antibodies; providing energy; and regulating bodily processes. The amount of protein needed by each individual is influenced by several factors including the following:

- age
- body size
- physical state
- quality of the proteins ingested

The structural units of protein are called ***amino acids.*** Amino acids can be found in every cell of the body. These amino acids can be broken down into two categories: essential and nonessential. ***Essential amino acids*** are those that must be provided in the diet. The body cannot produce essential amino acids sufficiently to meet the body's needs. ***Nonessential amino acids*** can be produced by the body in adequate amounts and do not need to be added to the diet.

Sources of proteins are animal food products and plant food products. Animal food products are the best sources of proteins because they supply all of the essential amino acids needed by the body. Because they supply all of the essential amino acids needed by the body, they are called ***complete proteins.*** Sources of complete proteins include the following:
- meat
- milk
- cheese
- eggs
- poultry
- fish

Plant food products supply many amino acids, but they do not contain all of the necessary amino acids. Plant food products are considered incomplete proteins. ***Incomplete proteins*** do not contain all of the essential amino acids needed by the body. Plant food products include the following:
- cereals from the various grains
- vegetables
- fruits
- legumes (dried beans and peas)
- nuts

Eating an animal source of protein or combining certain plant protein sources daily gives a person a good supply of needed proteins. The availability of protein varies in different parts of the world. In the United States, the supply of animal protein is in excess of the amount needed. In countries such as India, Iran, Pakistan, and Egypt, the supply of animal protein is limited while there is an abundance of plant protein available. Therefore, their diets are based on legumes, cereal grains, and tubers. Sugar, which has no protein, is the main source of calories in some countries. In countries such as Africa and Brazil the main dietary food is cassava meal, which contains only 1 percent protein. Whether animal or plant protein is consumed by a particular country or culture is largely dependent upon the type of protein available to the consumer.

Religious and cultural beliefs also influence a person's diet. Some societies do not believe in killing or eating animals. These societies practice ***vegetarianism*** or eating foods of vegetable origin and none of animal origin. Other people avoid eating certain meats due to religious reasons. Others are allowed to eat only meat of animals that are killed under certain conditions.

Individuals who choose not to eat animal protein must eat other foods or combinations of foods that will provide adequate protein in their diet. It is possible to combine two products with limited amino acids (or incomplete proteins) in the right amounts to produce the equivalent of an essential amino acid, thus providing the diet with adequate protein. Examples of foods with incomplete protein or vegetable protein foods include legumes, nuts, seeds, whole grains, and vegetables. Examples of these foods are included in figure 20.2

Example combinations of foods with incomplete proteins that produce the equivalent of complete proteins include the following:
- legumes and rice
- whole wheat bread and peanut butter
- nuts and legumes
- lentils and rice
- beans and corn (bean taco or burrito)
- leafy vegetables, legumes, and cereals
- milk and cereals
- macaroni and cheese

Soybeans are the most widely used substitutes for animal protein because of their high protein content. The soybean has become an important component of the American diet with

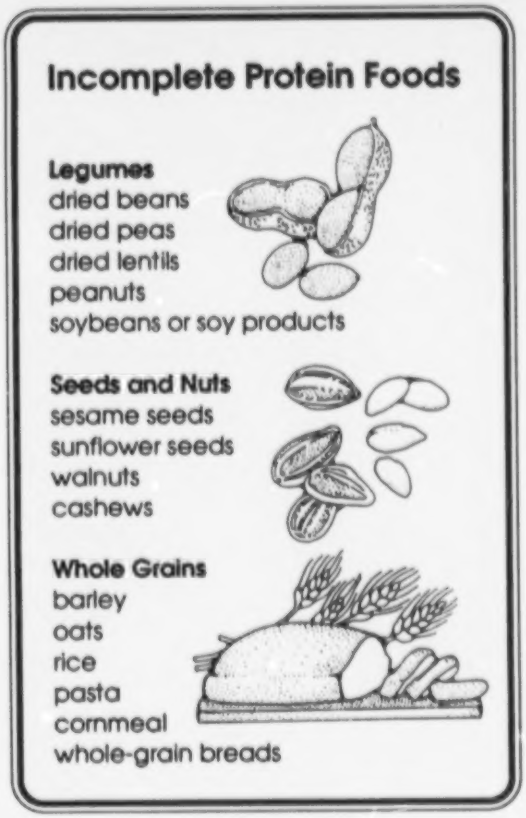


Figure 20.2

its use in cooking oils and margarine and in the meat and poultry industries. When used as a milk substitute, soy milk must be fortified with calcium salt and is often fortified with B_{12} and other vitamins and minerals. Without this fortification, the milk has only 25 percent as much calcium as regular cow's milk. Before purchasing soy milk, the consumer should make sure the product has been fortified with minerals and vitamins.

Soy concentrate is a protein concentrate of approximately 70 percent. It is formed through a process which extracts all of the oil and most of the soluble carbohydrates from the soybean. This soy concentrate can be processed into a granular form and used in other foods such as ground meat products, snacks, cereals, baby foods, and sausage products.

Soy protein can be blended with other vegetable proteins as well as carbohydrates, minerals, vitamins, fats, flavors, and colors to form products that look and taste like real meat, fish, and chicken products. These products, called ***analogues***, contain about 50 percent protein. This percentage of protein is higher than that of real meat, which only contain 15 to 30 percent protein. Ingredients typically used in food analogues include the following:

- vegetable proteins such as wheat gluten and soy
- corn, cottonseed, and soybean oils
- water
- oats
- salt
- rice starch
- modified corn starch
- stabilizers
- emulsifiers
- onions
- garlic
- minerals
- vitamins
- colorings
- flavors
- fats
- carbohydrates

Plant foods are usually high in fiber. The fiber may affect the body's ability to digest the plant protein found in vegetables. This can make it more difficult to consume adequate protein levels. Most plant foods are not only high in fiber but also low in calories. If a person does not consume enough calories, the body must rely on protein to provide the body's energy supply. A diet sufficient in protein but lacking in calories results in a diet that is insufficient in protein as well. Sufficient calories must be included in the diet to keep this from happening.

Another problem can occur when a person does not eat animal protein. A lack of foods from animal origin may result in a deficiency of vitamin B_{12}. Vitamin B_{12} is found only in foods of animal origin. Individuals who do not eat animal protein need to supplement their diets with vitamin B_{12}.

When planning a diet that does not incorporate animal proteins, the following guidelines should be followed:

- Supplemental plant proteins must include a wide variety of legumes, nuts, whole grains, or imitation meats processed from soybean or other plant proteins.
- Two to three servings of milk or milk products should be included in the diet. If no animal products are consumed, fortified soybean milk and a B_{12} vitamin supplement should be included.
- Legumes such as dried beans, lentils, peanuts, and soybeans; seeds such as sesame and sunflower; and green leafy vegetables such as broccoli, turnips, or spinach should be eaten daily to replace a lack of calcium that milk or other dairy products would provide. A cup of broccoli, turnips, or spinach has the same amount of calcium as a cup of milk.
- Large quantities of fiber should not be added. Sufficient amounts are already available in the vegetarian diet.
- Citrus fruits, which are sources of vitamin C, and dark green leafy or yellow vegetables, which are sources of vitamin A, should be eaten daily.

CARBOHYDRATES

Carbohydrates furnish most of the energy needed by the body to move, perform, work, and live. Carbohydrates also help the body use fats efficiently and provide bulk or fiber to the body. If the amount of carbohydrates available to be used for energy is insufficient, the body will get energy from its fat and protein resources. This keeps protein from performing its other more important functions.

Carbohydrates come in three forms including the following:

- sugars (simple carbohydrates)
- starches (complex carbohydrates)
- cellulose (complex carbohydrates)

Starches and sugars are the body's main supply of energy. About half the calories eaten should come from carbohydrates. The dietary guidelines recommend that only 10 percent of carbohydrates come from sugar. Cellulose supplies bulk to the body.

Carbohydrates can be classified into three categories: monosaccharides, disaccharides, and polysaccharides. ***Monosaccharides*** are the simplest form of carbohydrates. The monosaccharides are glucose, fructose, and galactose. These monosaccharides can be found in the following foods:

- Glucose is found in fruits, corn, and corn syrup. It is also known as blood sugar. It is the byproduct formed after the more complex carbohydrates have completed the digestion process.

- Fructose is in honey and fruit. Fructose also is known as the most concentrated and sweetest of all sugars.
- Galactose is not found in nature, but it is derived from the breakdown of lactose.

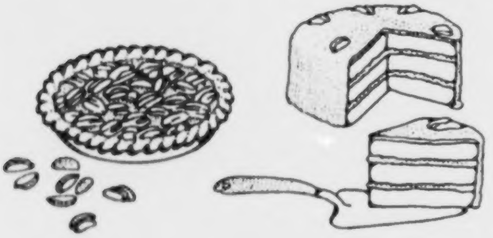
Disaccharides are double sugars. Double sugars include sucrose, lactose, and maltose. These double sugars are broken down into monosaccharides or simple sugars during the digestion process so that they can be absorbed by the body. The disaccharides are sucrose, maltose, and lactose. These disaccharides can be found in the following foods:

- Sucrose is cane or beet sugar found in table sugar, brown sugar, and confectioner's sugar.
- Maltose is malt sugar that is found in sprouting cereal grains and is used in breads and cereals.
- Lactose is sugar found in milk and milk products.

Polysaccharides are the most complex carbohydrates. *Poly* means many and *saccharides* means sugars. Polysaccharides include starch, dextrin, cellulose, and glycogen. Starch is the most abundant polysaccharide. Polysaccharides can be found in the following:

- Starch is found in roots, legumes, grains, and vegetables.
- Starches are broken down into dextrins during food processing. The word dextrin appears on some food labels. It is used as a thickening agent in certain foods.
- Cellulose is commonly referred to as fiber or roughage and is the fibrous material found in plants. It is in vegetables, fruits, and whole grain cereals.
- Glycogen is the storage form of carbohydrates. It must be converted to glucose in the body before it can be utilized by the body.

As discussed in Chapter Three, the average American consumes an estimated sixty to eighty pounds of sugar per year or approximately one-fourth pound per day. The high intake of sugar can be attributed to the amount of hidden sugars found in convenience foods and table sugar that people add to the foods they cook.



High-sugar foods or large amounts of sugar intake have been linked to health problems including the following:

- diabetes (a genetic disorder that is not caused by eating too much sugar but can be influenced by sugar intake)
- obesity
- heart disease
- tooth decay

The Dietary Guidelines for Americans suggests that individuals increase their intake of complex carbohydrates and decrease their intake of simple sugars or simple carbohydrates. Diets low in simple carbohydrates and high in complex carbohydrates are generally lower in fat and calories and higher in fiber, vitamins, and minerals than diets high in simple carbohydrates and low in complex carbohydrates. Figure 20.3 identifies examples of foods that contain simple and complex carbohydrates.

Simple Carbohydrates	Complex Carbohydrates
cakes	bread
candies	cereal grains
cookies	crackers
dried fruits	fresh fruits
jams and jellies	fresh vegetables
pastries	legumes
syrups	pasta
sugars	

Figure 20.3

Fiber is found in plant tissues. Cellulose is one type of dietary fiber found in food that originates from plants. Fiber also may be called roughage. Fiber provides bulk in the diet that cannot be digested by the body. It helps promote normal waste elimination.

Fiber is generally classified into two categories: soluble and insoluble. ***Soluble fiber*** is dissolved in water. It can help control diabetes and lower blood cholesterol levels. Soluble fiber helps lower blood cholesterol levels by removing bile salts from the intestines as the fiber passes through the body and is eliminated. Bile salt is a form of cholesterol. Soluble fiber is found in some fruits, beans, and oat bran.

Insoluble fiber cannot be dissolved in water. Insoluble fiber helps foods move through the digestive tract. It aids in the prevention of colon and rectal cancer, helps prevent constipation, and helps control diverticulosis. Diverticulosis is characterized by out pockets or protrusions of the intestinal wall. These pockets can become infected. Sources of insoluble fiber include fruits, vegetables, wheat bran, whole wheat, and some legumes.

Grains and Pastas

According to the United States Department of Agriculture (USDA), federal enrichment standards for pasta and grains exist for corn grits, cornmeal, wheat flour, rice, macaroni, and noodle products. These products are not required to be enriched. Only those products labeled as enriched must contain specified minimum nutrient levels. These laws are enforced at the state level rather than at the federal level. Many states do not require these products to be enriched. Most national brands are enriched.

Federal standards specify the enrichment levels or ranges of grains and pastas for the following:

- iron
- niacin
- riboflavin (excluded from enriched rice since 1958)
- thiamin

Grains. Corn and cornmeal products are available in white, yellow, and blue varieties. Yellow corn products have higher vitamin A than the white and blue varieties. The nutrient compositions of yellow and white corn are similar with the exception of the vitamin A content.

Mesa corn flour is milled from corn that has been soaked in a lime or calcium hydroxide chemical solution. This process facilitates the removal of the outer hull of the corn grain and gives the characteristic flavor of authentic corn tortillas. Mesa corn flour is higher in calcium than other corn products because of the lime process.

Self-rising flours and cornmeal have more calcium, phosphorus, and sodium than other flours and meals because of the addition of the chemical leavening agents and salt. The most commonly used chemical leavening agents include the following:

- monocalcium phosphate
- sodium acid pyrophosphate
- sodium aluminum phosphate
- sodium bicarbonate

Salt is added to self-rising flours and meals for seasoning purposes.

Wheat flour tortilla mix is used for making flour tortillas and other related products. The mix has calcium carbonate added. The addition of calcium carbonate makes flour tortillas higher in calcium than other wheat flour products.

Pasta. Protein-fortified pasta, macaroni, and noodle products are available on the market today. These products are available both with and without added vegetable shortening. Protein-fortified macaroni products usually contain wheat germ, dried yeast, or other ingredients that increase the protein content. A macaroni product labeled "with fortified protein" under USDA federal standards must have a protein content of at least 20 percent and a protein quality not less than 95 percent of that of casein (a protein found in milk and cheese).

Corn pasta is available primarily to meet the needs of individuals who are allergic to wheat. It is made exclusively from corn flour. Since the product contains no wheat flour it is not required to meet federal standards for macaroni or noodle products.

Breakfast Cereals

The first breakfast cereals containing added nutrients appeared on the market in the early 1940s. The nutrients added were iron, niacin, riboflavin, and thiamin. The amount of the nutrients added to the cereals restored them to whole grain levels. Cereals fortified to higher levels appeared on the market in the early 1950s. By 1969, approximately 16 percent of the breakfast cereals were fortified with nutrients. Today almost all breakfast cereals are nutrient fortified. Nutrients added to breakfast cereals today include the following:

- iron
- niacin
- riboflavin
- thiamin

The following are other nutrients that also may be added:

- vitamin B_6 (pyridoxine)
- vitamin B_{12} (cyanocobalamin)
- vitamin A (retinol)
- vitamin C (ascorbic acid)
- vitamin D (calciferol)
- folate
- iron
- zinc
- vitamin E (alpha tocopherol)
- pantothenic acid
- copper
- calcium

In most cases, nutrients are added in quantities that provide 25 percent of the United States Recommended Daily Allowances (RDA) per serving of cereal. If a cereal has a fortification of 50 to 100 percent of the RDA, it may be labeled as a dietary supplement.

Breakfast cereals are typically eaten with milk but can be eaten dry. One-half cup of milk is generally the amount used by manufacturers to indicate nutritional information to the consumer. The addition of milk not only adds flavor and appeal, but it also adds nutrients.

VITAMINS AND MINERALS

Vitamins are organic compounds necessary in small amounts in the diet for normal growth, maintenance of health, and reproduction. Vitamins help the body convert carbohydrates and fat into energy and assist in the formation of bones and tissues. Vitamins must be provided from the diet because the body cannot produce them or cannot produce the quantity necessary.

Minerals are inorganic substances that become part of the bones, tissues, and body fluids. Carbohydrates, proteins, vitamins, and fats comprise approximately 96 percent of human body weight. The other 4 percent is made up of minerals.

Vitamins

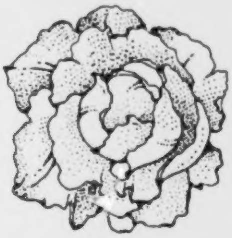
Vitamins are either soluble in fat or water. ***Fat-soluble vitamins*** can be readily stored in the body. ***Water-soluble vitamins*** are not stored in the body. They are easily dissolved by the water and must be replenished daily.

Fat-soluble vitamins are vitamins A, D, E, and K. The functions and sources of each of the fat-soluble vitamins are listed in the following:

- ***Vitamin A*** (retinol) is responsible for night and color vision, growth of bones and teeth, and production of healthy skin. Sources of vitamin A include dark green and dark yellow vegetables, fruits, egg yolks, whole milk, liver, butter, and fish oils.

- ***Vitamin D*** (calciferol) provides normal growth and development, support for normal bone mineralization, and stimulation of the active absorption of calcium and phosphorus. Sources include egg yolks, liver, fish liver oils, and fish filets.

- ***Vitamin E*** (alpha tocopherol) protects cells from oxidation It is added to other foods to reduce or slow spoilage. Sources include vegetable oils, wheat germ, vegetables, meat, butter, egg yolks, fish liver oils, and green leafy vegetables.
- ***Vitamin K*** (menaquinone and phylloquinones) is necessary for blood clotting. Sources include green leafy vegetables, broccoli, peas, liver, cheese, and eggs.

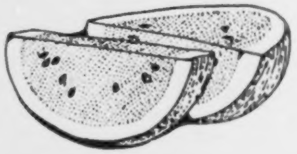


Water-soluble vitamins include the B vitamins and vitamin C. The functions of each of the water-soluble vitamins and sources of each are listed in the following:

- ***Vitamin C*** (ascorbic acid) aids in the formation of hemoglobin, helps fight infection, aids in healing of wounds, aids in the formation and maintenance of collagen, and aids in the absorption of iron and calcium. Sources include citrus fruits, cantaloupe, strawberries, leafy green vegetables, broccoli, cabbage, and green peppers.

- ***Thiamin*** (vitamin B_1) is necessary for cell respiration, promotion of normal appetite and digestion, and maintenance of a healthy nervous system. It helps break down carbohydrates in the body and helps the body release energy from food. Sources include enriched cereals and pork. It can be found in most foods except refined sugars, oils, and fats.
- ***Riboflavin*** (vitamin B_2) is necessary for the body to break down carbohydrates and keep the skin, tongue, and lips in normal condition. Sources include glandular meats, cheese, milk, eggs, leafy green vegetables, enriched breads, lean meats, and legumes.
- ***Niacin*** (vitamin B_3) is vital to the nervous system. It helps cells use other nutrients and is beneficial for the mouth, skin, and tongue. It helps the digestive tract to function properly. Sources include liver, lean meats, whole grains, nuts, legumes, and brewer's yeast.

- ***Folate*** is necessary for the body to produce normal blood cells and for the biochemical reactions of cells in the production of energy. Sources include wheat germ, wheat bran, yeast, leafy green vegetables, liver, and legumes.
- ***Biotin*** is essential in the breakdown of carbohydrates, lipids, and proteins in the body. Sources include liver, kidney, egg yolk, vegetables, and fruits (especially bananas, grapefruit, watermelon, and strawberries).



- ***Pantothenic Acid*** aids in the metabolism of energy and in the production of antibodies. Sources include all plant and animal tissues with the best sources being liverwurst, meats, poultry, egg yolk, wheat germ and rice germ, tomato paste, sweet potatoes, oatmeal, and milk.
- ***Pyridoxine*** (vitamin B_6) is needed to help nervous tissues function normally, to maintain the health of the skin and red blood cells, and to participate in the metabolism of proteins, carbohydrates, and fats. Sources include liver, lean meats, cereals, vegetables, and milk.

- ***Cyancobalamin*** (vitamin B_{12}) is necessary in the development of normal growth, normal functioning of all body cells, and protection against pernicious anemia. Pernicious anemia primarily results from the body's inability to absorb vitamin B_{12}; however, it can result from a deficiency of vitamin B_{12} in the diet. Vitamin B_{12} is found only in animal protein. Liver, clams, oysters, muscle meats, eggs, chicken, and milk are the best sources.

A routine vitamin supplementation is generally not necessary unless a person's diet is chronically poor, unbalanced, or is composed of unenriched and unfortified foods. Individuals in one of the following four categories also may require a vitamin supplement:
- alcoholics
- elderly who are not eating well
- pregnant women
- individuals with gastrointestinal malabsorption problems

In most circumstances, vitamins taken in excess are of no value. Too much of vitamins A and D can cause the most trouble. Fat-soluble vitamins not used by the body are stored in fat, making a buildup of the excess more likely and more toxic. Water-soluble vitamins not used by the body are excreted in the urine, making it less likely for them to build up and become toxic.

Minerals

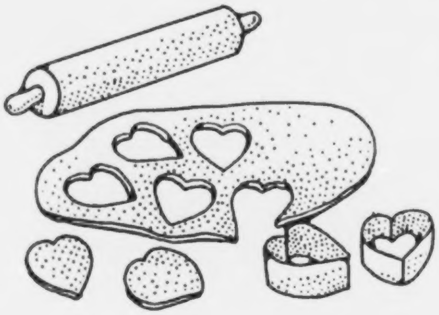
Minerals are necessary for building bones, tissues, and other compounds as well as for regulating body processes. Minerals found in large amounts in the body are called ***macrominerals***. Macrominerals include calcium, phosphorus, magnesium, sodium, potassium, and chloride. Minerals found in small amounts in the body are called ***trace elements*** or ***microminerals***. Trace elements are iron, iodine, zinc, and fluorine.

Table 20.1 lists macrominerals, their primary functions, and sources. Table 20.2 lists primary functions and sources of microminerals.

FATS

The term ***lipids*** is often used interchangeably with the term fat. Lipids in the simplest forms are called ***fatty acids***. Fats or lipids are important sources of energy needed and used by the body. The functions of fat in the body include the following:
- provide energy
- transport and absorb fat-soluble vitamins
- cushion vital organs in the body
- comprise part of the structure of body cells
- supply essential fatty acids
- add flavor to foods
- satisfy appetites by delaying hunger
- insulate the body
- serve as protection for nerves and blood vessels

Foods that contribute fat to the diet include butter, margarine, lard, chicken, meat, salad dressing, vegetable oil, milk and milk products, fish, nuts, olives, avocados, and whole grain cereals. Fats are also found in many baked goods, desserts, and snacks.



The total amount of fat in the diet should be kept to a moderate level. An individual's diet should consist of no more than 30 percent fat. Many sources recommend that of this 30 percent, 10 percent should come from saturated fats, 10 percent from unsaturated fats, and 10 percent from polyunsaturated fats. Polyunsaturated fats found in plant food products are the best types of fat for human consumption and can substitute for saturated fats. For more information on fats, refer to Chapter Nineteen.

Macrominerals

Macromineral	Functions	Sources
Calcium	It is necessary for bone rigidity, blood clotting, muscle contraction, and normal nerve functions. Just because an individual eats food containing calcium does not mean that the body absorbs the calcium. Factors that increase calcium absorption include an overall balanced diet and intake of vitamins D and C and certain amino acids. Factors that decrease calcium absorption include a vitamin D deficiency, fat malabsorption, eating large amounts of fiber, lack of exercise, stress, and lactose deficiency or lactose intolerance.	Milk and milk products, soft-boned fish, mechanically deboned meat, leafy green vegetables, and broccoli.
Phosphorus	It helps build strong bones and teeth and is a significant factor in all phases of calcium metabolism.	Meat, poultry, liver, fish, eggs, milk and other dairy products, raw oranges, cherries, peaches, potatoes, rice, and wheat flour. Eating foods high in calcium will provide adequate phosphorus in the diet.
Magnesium	This macromineral helps regulate body temperature, muscle contractions, and the nervous system. It helps cells utilize carbohydrates, fats, and proteins.	Green leafy vegetables; nuts including Brazil, almonds, and cashews; muscle meats; salmon; cheddar cheese; beef liver; milk; and eggs. Vitamin D increases the absorption of magnesium.
Sodium, chloride, potassium	These three work together to regulate the flow of fluids in the body as well as to help regulate the nervous system, muscle functions, and nutrient absorption in the cells.	Sources for sodium and chloride are found in table salt while potassium can be found in meats, milk, bananas, leafy green vegetables, and citrus fruits.

Table 20.1

Microminerals

Micromineral	Functions	Sources
Iron	It is found primarily in the blood where it combines with protein to form hemoglobin (oxygen-carrying protein in the blood).	Liver and other organ meats, egg yolks, dried legumes, shellfish, leafy green vegetables, and enriched breads. It is estimated that only 10 to 15 percent of the iron in food is actually absorbed.
Zinc	Zinc is necessary in the release of oxygen from the lungs.	Oysters, herring, egg yolks, and organ meats.
Copper	Copper is necessary in the formation of hemoglobin.	Liver, bran flakes, and cocoa powder.
Manganese	The role of this micromineral is not well understood.	Nuts, rice, whole grains, beans, and leafy vegetables.
Selenium	It works in conjunction with vitamin E to protect cells from destruction. It has been suggested that selenium may have a role in the prevention of cancer.	Fish, organ meats, shellfish, and eggs. Grains and other plants grown in selenium-rich soil are also good sources.
Chromium	This micromineral maintains the normal glucose uptake into cells and helps insulin bind to cells.	Vegetable oils, egg yolks, whole grains, and meats. Fruits, vegetables, highly processed foods, and drinking water are generally poor sources of chromium.
Iodine	It is necessary for the thyroid gland to produce thyroxine. Thyroxine is essential for the oxidation rates of cells in the body.	Iodized salt, ocean fish, seaweed, and milk.
Fluoride	Fluoride is needed to protect teeth from decay.	Fluoridated drinking water, seafood, tea, fluoridated toothpaste, and fruits and vegetables grown in areas where the natural fluoride level in water is high.

Table 20.2

WATER

Water is necessary in the body for many reasons. It acts as a solvent for nutrients and hormones. It acts as a transport mechanism for nutrients to cells and for ridding the body of waste products. It serves as a lubricant in joints; facilitates food passage; and regulates body temperature through conduction of heat, perspiration, and excretion.

The body typically uses two to two and one-half liters of water per day. It is recommended that the daily diet include at least eight 8 ounce glasses of water per day. Sources of water include beverages, soups, water, and milk. Other sources of water include the following:

• vegetables	87 percent
• fresh fruits	86 percent
• eggs	74 percent
• beef	60 percent
• bread	36 percent

Summary

- ☐ No one food contains all of the nutrients necessary for the body to function effectively; therefore, a balanced diet that incorporates appropriate amounts of the six basic nutrients as well as appropriate servings from the basic food groups is necessary.
- ☐ Individuals should choose foods of high nutrient density rather than empty calories.
- ☐ Essential amino acids are those that must be provided in the diet. Nonessential amino acids can be produced by the body in adequate amounts and do not need to be added to the diet.
- ☐ Eating either an animal source of protein or combining certain plant protein sources gives a person a good supply of needed proteins or complete proteins.
- ☐ A diet sufficient in protein but lacking in calories will result in a diet that is insufficient in protein as well.
- ☐ Soybeans are the most widely used substitutes for animal protein because of their high protein content.
- ☐ Diets that are low in simple carbohydrates and high in complex carbohydrate foods are generally lower in fat and calories and higher in fiber, vitamins, and minerals than diets high in simple carbohydrates and low in complex carbohydrates.
- ☐ Federal enrichment standards exist for corn grits, cornmeal, wheat flour, rice, macaroni, and noodle products. They do not have to be enriched, but if the product is labeled as enriched, it must contain specified minimum nutrient levels.
- ☐ Vitamins are organic compounds necessary in small amounts in the diet for normal growth, maintenance of health, and reproduction.
- ☐ Minerals are inorganic substances that become part of the bones, tissues, and body fluids.
- ☐ Fats are important sources of energy needed and used by the body; however, the total amount of fat in the diet should be kept to a moderate level.

Vocabulary

amino acids
analogues
biotin
calcium
chloride
chromium
complete proteins
copper
cyancobalamin
disaccharides
empty calories
enrichment
essential amino acids
fat-soluble vitamins
fatty acids
fluoride
folate
fortification
incomplete proteins
insoluble fiber
iodine
iron
lipids
macrominerals
magnesium
manganese
microminerals
minerals
monosaccharides
niacin
nonessential amino acids
nutrient dense
nutrification
pantothenic acid
phosphorus
polysaccharides
potassium
pyridoxine
restoration
riboflavin
selenium
sodium
soluble fiber
soy concentrate
thiamin
trace elements
vegetarianism
vitamin A
vitamin C
vitamin D
vitamin E
vitamin K
vitamins
water-soluble vitamins
zinc

Review

1. How do fortification, enrichment, and restoration differ?
2. What makes foods nutrient dense?
3. What factors influence the amount of protein needed by individuals?
4. What are the two sources of proteins and examples of each?
5. What are analogues? What are their advantages?
6. If grains and pastas are labeled enriched, which nutrients must be present?

7. What are the two classifications of fiber? What are their characteristics?
8. Are routine vitamin supplements necessary?
9. What is the difference between macrominerals and microminerals?
10. How do simple and complex carbohydrates differ?
11. What are the characteristics of protein-fortified macaroni products?
12. What are two examples of incomplete protein foods that can be combined to produce the protein equivalent of essential amino acids?
13. What are the six basic nutrient groups and the significance of each?
14. What are empty calories and why should they be limited?
15. How do the diets of vegetarians differ from the diets of individuals who are not?
16. What are the three forms of carbohydrates?
17. What role does cellulose play in the diet?
18. What nutrients are typically added to breakfast cereals today?
19. How do water-soluble vitamins and fat-soluble vitamins differ?
20. How is water beneficial to daily body functions?

Critical Thinking

Record everything you eat for three days. Using the Recommended Dietary Allowances published by the National Academy of Sciences for the U.S. government, compare your records with the RDA to see if your meals were nutritionally balanced. If they were not, which nutrients were missing from your diet? What generalizations can you make about your diet overall? What do you think might happen if you maintained this same diet for the next five years? What long-term effects might this have on your health? What changes can you make to improve your diet? How can you include more nutrified foods in your diet? What other changes would help improve your overall nutritional health?

21

New Forms and Sources of Foods

ESSENTIAL ELEMENT

- ❑ Evaluate new forms and sources of foods and food products.(j4A)

OBJECTIVES

- ❑ Determine various advances in food technology and predictions for the future.
- ❑ Identify food testing and evaluation procedures in food science and nutrition.

The process by which food products arrive at the dinner table today is more often than not, very different than the process used fifty years ago. The food industry has been greatly influenced by economical trends, technological developments, and lifestyle changes.

ADVANCES IN FOOD TECHNOLOGY

Foods, just as clothing, go in and out of style. People are very health conscious today, and the trend is away from eating heavy meat and potato meals and toward eating low-calorie, low-fat meals. Technology has greatly influenced the ability to determine the nutrient content of foods and the ability to make food products more nutritious.

Research has increased in the food science industry. Basic chemical and physical principles have become the foundations of food science and nutrition and the nation's food supply. Certain professionals have specialized in the development of new food items for the average consumer as well as for the commercial food service industry.

Lifestyle changes related to food include the importance of the following:

- taste, fresh foods, and variety
- convenience foods
- natural foods
- price/value
- lower fat and cholesterol
- lower calories
- lower salt

Foods available today come in a variety of forms. Forms include the following:

- canned
- dehydrated
- dehydrofrozen (frozen and dehydrated)
- freeze-dried
- raw/fresh
- frozen
- individually quick frozen (IQF)
- microwavable
- partially prepared
- packaged dry mixes
- ready-to-serve
- retort packages

The shelves at grocery stores are often full of new and improved products. Many of these are semiprepared and prepared food products developed to shorten preparation and/or cooking time.

Food Packaging

Determining the appropriate packaging for a product is a complicated task. Every food product is unique. Packaging that works for one product does not necessarily work for another. Today's market demands convenience and quality for both the packaging and the product.

Food packaging used to be a relatively simple, uncomplicated task. Today, food packaging also serves as food marketing or advertising. Its goal is not only to keep the food it surrounds fresh, but it also must capture the attention of consumers and encourage them to buy the product. With more than 12,000 products on grocery store shelves, competition among food products is at an all-time high. Packaging has become extremely important.

BEANS
LIVER
Peanut Butter

MACARONI
CEREAL

A significant amount of research and time goes into the selection of a package cover. The packaging must be appropriate for the food it holds, and the package cover design must be attractive to the customer. Packaging costs can be as much as 30 to 40 percent of the final product cost.

Several steps are involved in product packaging selection. Scientists, researchers, technicians, and chefs are all involved. The first step in developing the right packaging is to identify materials used successfully on similar products. Materials often include cellophane, different types of plastic wrap, and foil. The product is then wrapped in various packages, weighed, and placed in rooms that maintain different temperatures and humidity levels.

The products are weighed in their packaging after a specified amount of time to determine the amount of moisture lost. If a product weighs less after two weeks, then the packaging is less than effective. The packaging is altered and the product is placed in the controlled rooms and tested again.

The packaging selection process also includes food tasters who sample the food after the products have been tested in controlled rooms. The products are sampled to determine how the packaging materials affect their taste. The process continues until the right packaging formula is determined. The next step is to determine the type of seal to use, type and color of ink to use on the package, and the opening and closure of the package.

Few of the new products found on the market today are packaged in cans or glass containers. New products are primarily packaged in containers made of laminated polymer films or plastics. Some packages are made with as many as seven layers of paper, polymer, and thin metal films. With flexible packaging come many concerns about safety and durability. The following represent some concerns of flexible packaging:

- microbial contamination
- contamination from the polymer product

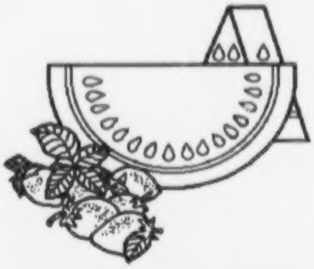
- reduced shelf life
- damage to the seal of the package

New Products for the Food Service Industry

Demographic trends (characteristics of a population) have a significant impact on the food service industry. A slower population growth is predicted for the coming years implicating a more intense competition for customers in the industry. Racial and ethnic diversity is growing and forcing the industry to target menu offerings, provide a broader range of ethnic foods, and offer more diversity in food products in general. Marketing will become increasingly important in the years to come.

Consumers are looking for foods that are low in fat, low in calories, fresh, flavorful, convenient, and high in fiber. Foods such as seafood, oat bran, and broiled or baked chicken are items they seek. At the same time, consumers still want foods such as candy, cookies, and ice cream. Some of these types of foods now contain fat and salt substitutes. In this respect, the food service industry is meeting customer demands and trends by developing healthier versions of food products which may look and taste the same as the previous version.

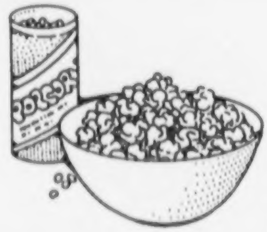
The food service industry shows that consumers are snacking more than in the past, but they want to feel as though they are snacking less and that the foods they are snacking on are healthier. Miniature-sized snacks, single serving products, and smaller portion sizes of higher calorie meals are some of the ways the industry is responding. The name of the product also influences consumers' perception of the product.



With more women in the work force and the shift in the age of the population, the convenience food market has grown rapidly. Consumers want fast foods, finger foods, microwavable items, and self-serve food items. Popular products include chicken fingers and nuggets, potato skins, minipizzas, egg rolls, and fajitas.

In restaurants, consumers want quality, variety, moderate prices, and nutritionally superior foods. Basic menu items include simple meats, poultry, and fish. Even pizza restaurants are meeting customer demands by developing "light" pizzas that contain less fat and salt than regular varieties. Other consumer demands include extended hours and convenient food delivery.

Vending machines also have been influenced by health trends as well as consumers' desires for quality products, variety, and moderate prices. Most individuals identify quality with trusted brand names. Vending machine companies are meeting this demand by placing name brand snacks in their machines. Cold drinks, hot drinks, and various snacks are common in vending machines. The growing desire for microwavable products also has influenced vending machine companies. Microwave popcorn is probably the most common microwave food available in vending machines today. Microwavable dinners are processed in vacuum-sealed packages, or retorts. These are being developed for sale in vending machines.



Technological Advances in Agriculture

It is estimated that only 2 percent of the population of the United States are farmers.

Only a small percentage of the farms are family operated. Food production has become a large scale business. Technological advances have made major impacts in the farming industry with new methods of irrigation, breeding of plants, and test-tube breeding of cows. Technology is expensive. Few family farm owners can afford the high costs of technology.

Food production is known less as agriculture and more as agribusiness. Agribusiness (turning conventional agriculture into a business) allows a higher percentage of quality products to be produced and creates higher yields with a more efficient use of natural and human resources.

Genetic manipulation of cells has been around for hundreds of years. It is now known as ***genetic engineering***. It is probably the oldest form of plant breeding. Early farmers saved the seeds from their best plants and used them for replanting the following year. The plants that produced the largest yield and had the greatest tolerance to environmental conditions were used. The general concept of genetics has remained the same, but the selection process has become more sophisticated.

The two methods of genetic manipulation used today are recombinant DNA and cell fusion. ***Recombinant DNA*** refers to the process of taking a gene or protein from one source and adding it to the DNA (genetic makeup) of another source to produce a new microorganism or modify an existing one. ***Cell fusion*** refers to combining two cells from different species in order to combine their genetic material and create a new organism.

Hybrids are new strains of plants created through crossbreeding. They are bred to produce particular strengths such as resistance to disease and drought. Polyculture is a concept that many experts see for the future of the agribusiness industry. ***Polyculture*** refers to growing a variegated mixture of crops. An example of polyculture would include combining fruits and vegetables. A whole new variety of foods can be provided through this process.

A high-producing milk cow—one that produces 23,000 pounds of milk each year compared to 13,000 pounds from an ordinary milk cow—can be given an ovulating hormone to cause it to produce extra ova (eggs). Once fertilized, eggs are taken from the female and transplanted into ordinary milk cows. Calves are born that will be able to produce approximately 23,000 pounds of milk per year, thus increasing the amount of milk available for processing.

Breeders also have learned how to examine a fertilized egg and determine its sex. For dairy farms, this process can be very important. Dairy farms need females. Males are typically an added expense. On the other hand, beef ranchers have a greater need for males. The appropriate eggs can be sorted with dairy breeders using the female eggs of dairy cows, beef ranchers using the male eggs of beef cows, and those not needed discarded. These fertilized eggs can be frozen under certain situations, sold, and transported to other countries where they can be implanted into native cows. The eggs can be transported more inexpensively than the cow. Another advantage of this method is that the native cow and the embryo automatically have a resistance or immunity to local diseases.

The primary concern with genetic engineering is not knowing if a particular genetic change or combination that is presumed to be beneficial will turn out to have negative effects. The recombinant DNA technology is more accurate in predicting potential problems than traditional breeding in which two complete sets of genetic material are combined randomly.

Aquaculture

The consumption of fish in the United States has increased approximately 30 percent since 1970. The number of fish available from the oceans has decreased. The fish demand has encouraged the development of a new industry called aquaculture. ***Aquaculture*** refers to fish and fish farms primarily but also covers almost anything that can be raised in water. Some vegetables are grown in water ***hydroponically*** without the aid of soil. Hydroponically grown vegetables are considered aquaculture products.

Almost all catfish and crayfish eaten today are raised on farms. A large percentage of oysters, rainbow trout, mussels, and shrimp are also aquaculture products. Approximately one-eighth of consumer seafood is produced by the aquaculture industry. Japan and China are currently the largest producers of aquaculture. Their primary products are finfish, shellfish, and seaweed.

Mussels raised on farms require two years to grow to their two-inch market size. It takes almost four years for them to grow to market size in conventional settings. Salmon, however, do not grow as quickly. They are held in pens in a stream until they are two years old, then they are released into the ocean to graze and fatten for three to five years. When the salmon mature, the plan is for them to return to the location where they were born. Some of them do return, but not all. When fish do not return, the cost of production for the fish that return increases.

In the future, aquaculture in the United States will continue to involve catfish but will incorporate more luxury products. Lobsters, clams, and jumbo shrimp will become increasingly popular aquaculture products.

FOOD TESTING AND EVALUATION

It is important to remember that with all of the changes and advances in food technology, the main emphasis of food technology is to provide safe and wholesome foods for consumption. Testing and evaluation are still of high priority with respect to food composition, food deterioration, food preservation, effects of food processing on the composition of foods, and food additives. Testing and evaluation ensures that these technological advances enhance the foods that are produced and ensure their safety for human consumption. Advances in food testing and evaluation have provided new and better analytical methods to ensure these qualities.

Food laws and regulations have been passed by Congress in an effort to protect the food supply. These laws and regulations are enforced by various government organizations such as the Food and Drug Administration (FDA) and the United States Department of Agriculture (USDA).

The Federal Food, Drug, and Cosmetic Act of 1938 was one of the most substantial regulations enacted to protect consumer health. The act specifies certain standards of identity, standards of quality, and labeling requirements. It prohibits the use of certain substances in foods and requires that all ingredients used be identified on the product label. Among the major provisions of the law are the following:

- adulterated foods – No food may contain any added poisonous or harmful substances that may cause health problems. No food should be decomposed, packed under unsanitary conditions, from a diseased animal, or from one that died from any means other than slaughter. The food should not be canned or packaged under any of these conditions.
- misbranded foods – These include foods that have false or misleading labels, foods that are

offered for sale under the name of another food, or food containers that are misleading in any way.
- standards of identity – The particular food product ingredients must meet federal ingredient standards or regulations and should only contain ingredients specified in the percentages specified.

Chemical, microbiological, and physical analyses of food products are the only ways to determine a particular food's quality and safety for human consumption. The information gathered through analysis is used for nutritional information regarding calories, fats, and proteins as well as for product labeling. The ***Association of Official Analytical Chemists (AOAC)*** has developed and is continuing to develop reliable methods for food testing and evaluation procedures and techniques to determine the quality and wholesomeness of agricultural products.

Samples of the food products used must be prepared appropriately before testing is begun. The food should be ground to almost a liquid state. Methods used to get the food into the necessary state include the following:
- agitation
- mechanical grinding
- mixing
- rolling
- stirring

Techniques Used

A substantial amount of information can be obtained from a basic analysis of a food's main components. The ***proximate analysis*** is a basic food analysis that can determine the main nutrient components of a food product including the following:
- ash
- crude fat
- crude fiber
- crude protein
- moisture

Ash. When organic or inorganic compounds are heated to a high temperature or when they decompose, the remaining substance is called ***ash***. By examining this ash, scientists can determine the amounts of trace elements and minerals in the food such as the following:
- calcium
- chloride
- iron
- magnesium
- manganese
- phosphate
- potassium
- sulfate
- sodium

Crude Fat. The mixture of fat-soluble materials in a food product is called ***crude fat***. Fat-soluble materials include the following:
- fat-soluble vitamins
- diglycerides
- monoglycerides
- triglycerides
- phospholipids
- fatty acids
- carotene pigments

The two methods commonly used for determining the crude fat content of food products are the dry extraction method and the wet extraction method. The wet extraction method is conducted with water remaining in the food sample.

Crude Fiber. The indigestible cellulose present in foods is called ***crude fiber***. The crude fiber content has little or no food value but provides the necessary bulk in the diet to aid in the digestion process. A test called the crude fiber method is the most common technique used. It dates back to the 1800s.

Crude Protein. All protein compounds in food are referred to as ***crude protein.*** Crude protein analysis does not necessarily mean analyzing actual protein. Protein is very difficult to extract from food products. Scientists determine the amount of nitrogen in various foods. Scientists assume that the nitrogen in the food after the analysis procedure is equivalent to that released from protein during the digestion process.

Moisture. The amount of water content of a food product is the ***moisture***. The moisture content of foods is an important factor in food quality, food preservation, and deterioration. Grain products that contain too much water tend to deteriorate quickly due to heating, insect damage, mold growth, and sprouting. Various methods are used for determining the water content of various products.

It is important to remember that all testing and evaluation methods can be used together. Both food experiments and tasting procedures are necessary. The information revealed from the testing procedures is needed to provide safe and wholesome foods for consumption.

Summary

- ☐ The food service industry is greatly influenced by economic trends, technological developments, and lifestyle changes.
- ☐ Foods available today come in a variety of forms including individually quick frozen, microwavable, partially prepared, packaged dry mixes, ready-to-serve, and retort packages.
- ☐ The goal of food packaging is not only to keep the food it surrounds fresh, but also to serve as a marketing device intended to capture the attention of consumers and encourage them to buy the product.
- ☐ Demographic trends have a significant impact on the food service industry.
- ☐ In restaurants, consumers want quality, variety, moderate prices, and nutritionally superior foods.
- ☐ It is estimated that only 2 percent of the population are farmers. Only a small percentage of the farms are family operated.
- ☐ Aquaculture refers to fish and fish farms primarily but also covers almost anything that can be raised in water.
- ☐ Testing and evaluation are of high priority with respect to food composition, food deterioration, food preservation, effects of food processing on the composition of foods, and additives.

Vocabulary

ash
Association of Official Analytical Chemists (AOAC)
aquaculture
cell fusion
crude fat
crude fiber
crude protein
genetic engineering
hybrids
hydroponically
moisture
polyculture
proximate analysis
recombinant DNA

Review

1. What are five forms in which food products can be purchased?
2. What percentage of the final food product cost reflects the approximate cost of product packaging?
3. In what ways are temperature and humidity controlled rooms used?
4. What materials are used for packaging new products today?
5. How will the predicted slower population growth affect the food service industry?
6. How have the growing number of women in the work force affected the food market?
7. Have contents offered in vending machines been influenced by lifestyle changes, technological developments, and economic trends? Why?
8. What are two advances in agriculture technology?
9. What are two advantages of hybrid plants?
10. What are two advantages of genetic engineering? disadvantages?
11. How does aquaculture benefit the food industry?
12. What is the main emphasis of food technology?

Critical Thinking

Visit a grocery store. Write down the variety of food forms you see. For example, fresh, frozen, and canned. Share your list with the class and compare with your classmates' findings. How many different forms of food did you find as a class? What reasons led food manufacturers to develop each of the food forms? Speculate about the supermarket of the future. Forecast the types of foods and food forms that will be available to consumers in twenty-five years. What will bring about these changes?

22

Research in Nutrition and Food Science

ESSENTIAL ELEMENT

☐ Summarize major research in nutrition and food science.(j4B)

OBJECTIVES

☐ Analyze various research methods used in food science and nutrition.

☐ Assess the relevance of research in the field of food science and nutrition.

☐ Evaluate a research project related to a current issue in food science and nutrition.

Nutrition has not always been recognized as a contributing factor to disease. The American Institute of Nutrition was established in the 1930s. Prior to that time, researchers focused their work on the germ theory of disease. Drugs and vaccines, such as smallpox vaccine, were developed to fight many diseases. It had been known for years that individuals could only contract smallpox once. Once a person has smallpox and recovers, she or he becomes immune to it. The original vaccine came from cows infected with cowpox. The smallpox virus can be injected into a calf or rabbit, causing lesions to form. The virus used for the vaccination can be obtained from these lesions. When the virus passes through one of these animal sources, it looses its ability to cause the normal reaction to the disease in the human body. Therefore, when a person receives the vaccination, the body actually receives the virus and produces the necessary antibodies (immunities). The body does not react to the virus as it would normally. The vaccine causes the body to react as if the person has had the virus and is immune to contracting the virus again.

Not long after scientists discovered vaccinations they discovered that some diseases resulted from certain deficiencies in the diet. Some of these diseases include the following:
- goiter – iodine deficiency
- pellagra – niacin deficiency
- rickets – vitamin D deficiency
- scurvy – vitamin C deficiency

Researchers discovered that these diseases could be cured by adding sufficient amounts of the appropriate nutrient to the diet.

Fewer people in the United States need to be as concerned about infectious or deficiency diseases as they were fifty years ago due to research methods using plants, animals, and humans. To maintain health in most cases, individuals need only eat a well-balanced diet with appropriate servings from each of the food groups. Fortification, enrichment, and general nutrition education have improved the quality of food products available and have increased the general public's awareness of the importance of good nutrition.

There is cause for concern, however, regarding chronic degenerative diseases such as cancer and heart disease. There is reason to believe that such diseases can be caused or influenced by both diet and genetic makeup or heredity. Biotechnology researchers are also concerned with the effects of the climate and soil conditions on the food supply. A problem with the food supply can result in problems related to diet and nutrition.

RESEARCH METHODS

Current research studies in the field of food science and nutrition involve genetic engineering as well as nutrition studies. In the areas of nutrition, researchers try to determine the following:

- What nutrients are needed for good health?
- What amounts of a particular nutrient is needed for good health?
- Which nutrients are people consuming, and in what amounts are they consuming them?
- Why is there a difference between the nutrients people need and what they actually eat?

Genes are the basic hereditary units of all living things. Each gene has two parts. One part is known as the switch. The switch tells the gene when to turn on and off. The other part is known as the coding center. The coding center houses the genetic blueprint for the product of the gene. These blueprints are also known as chromosomes. ***Chromosomes*** carry the hereditary characteristics of an organism. The number of chromosomes is constant for each species. Abnormalities occur when there is an increase in the number of chromosomes. Research in the field of genetic engineering is developing ways to correct these abnormalities as well as strengthen the normal genes.

Genetic engineering is a process by which scientists manipulate genes by introducing small amounts of foreign chemicals into the genetic makeup of an organism. ***Cytogenetics*** refers to the manipulation of genetics at the level of chromosomes. The organism will then take on new characteristics. This process enables scientists to move genes from one organism to another that could not normally be crossed or mated.

Plant and Soil Science Studies

Genetic engineering can be used on plants to promote resistance to various diseases and pests. The plant used most often for plant research is the ***Arabidopsis Thaliana***. The plant has a very simple genetic structure. Since this plant offers no agricultural benefits, experiments can be conducted first with this plant, then tried on agriculturally beneficial plants.

Cotton plant modifications have increased the plant's tolerance to certain herbicides. Other genes have been introduced to experimental cotton plants that produce a toxin deadly to the cotton bollworm. The cotton bollworm is a type of moth larva that feeds on and destroys the developing cotton bolls. Other genes have been introduced to produce increased yield varieties and colored cotton. Colored cotton has received much attention recently. Other genetic engineering in plants aids in pest resistance and builds tolerances to diseases. Genetic engineering of plants can also build resistance to environmental stresses, such as heat and drought, that can have negative effects on the plants.

Researchers are currently working on genetic engineering and flowers. The goal is to produce flowers with unusual colors. An example would include producing roses with colors such as blue or black. These elite colors could have a large market. Research also is being conducted to produce a gene to control the life of cut flowers.

Animal and Human Studies

Animals and humans are used in many scientific studies to help understand nutrition and to detect and cure various illnesses and diseases. The research is conducted by highly qualified individuals through careful planning and approved methods. Research is conducted by the following professional sources:

- food industry
- government information programs
- health professions
- medical research facilities
- university nutrition and food science departments

At one time, there were few legal restrictions on the use of humans for medical research. It was not uncommon for scientists to conduct their experimental research on humans, often using mental patients and prisoners. Ethical considerations led to legislation that restricted the use of humans. Scientists now interpret data collected from animal research and translate the data to humans. Humans are typically used after data has been collected from the animal research and specific conclusions have been drawn. Then, humans may be used with their written consent.

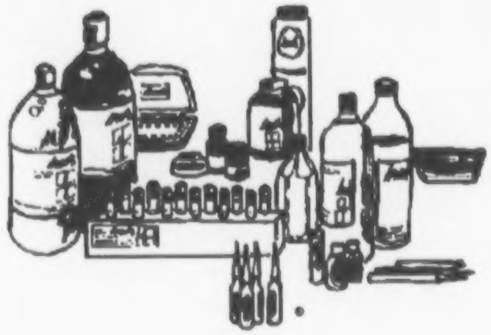
In animal research, the type of research to be done determines the types of animal used. The budget also may influence the choice of animals because some animals are more expensive to purchase and care for than others. The size, temperature controls, and capabilities of the laboratory are other determining factors. A license is required for labs before any experimentation can begin. The type of license is determined by the size and capabilities of the facilities.

Some animals are more suited to a particular experiment than others. For example, a rat should not be used in an experiment related to a vitamin C deficiency because vitamin C is not essential to the rat's diet. Rats do, however, need the B vitamins. This makes the rat a good participant in research related to the B vitamins. Guinea pigs need vitamin C in their diets, making them good candidates for research on vitamin C.

For research and development of antibodies, rabbits and goats are most useful. They have the capability to produce antibodies after being injected with antigens (toxins). This research and the animal's capabilities are quite beneficial to humans as well as other animals for fighting disease and infections. Antibodies also can be produced from cultures through biotechnology.

Monkeys are used in some experiments because they are the animals that are most closely related to man. The genetic makeup is very similar, making many research outcomes transferable to humans.

Mice are the preferred animal for laboratory experiments because they have a fast gestation (pregnancy) period and mature quickly. Rats often are used as well. In addition to their fast gestation period and rapid maturation, they also are inexpensive, require few laboratory capabilities, and are the least controversial animals for research. Rats and mice become good models for studying human health conditions such as cancer. Their quick maturation process enables researchers to determine results much sooner than with other animals.



Researchers are now experimenting with combining animal and human hormones. Human growth hormones are being injected into the ovaries of mice. Even though both male and female mice are of normal size, the offspring is much larger—almost twice the size of a normal mouse.

Human subjects are typically used in scientific research after a similar study has been conducted on animals or in the laboratory through cultures. Even though a technique or method may be beneficial to an animal or laboratory culture, it may not necessarily be beneficial in the human body. Volunteer human subjects have been used quite often for cancer prevention, cure procedures, and medications. Human subjects also have been used for AIDS prevention and experimental cures.

In the late sixties and early seventies, many people began to question the procedures used on some laboratory animals. Legislation was passed to establish guidelines for animal research to ensure that research methods used were ethical and did not cause the animal any unnecessary pain. Enforcement for the legislation is conducted by the United States Department of Agriculture (USDA). The legislation also called for committees to be established at each institution conducting any type of animal or human research. The committees are the following:

- Animal Care and Use Committee
- Human Subject Use Committee

In a university or medical school situation, these committees must report to the institution's research services department or office. Before any research can be done at an institution, the researchers must inform the appropriate committee of its plans, procedures, and intended use of the information received. The committee must then approve or deny the research request. If the research request is approved, the committee must monitor the research from start to finish. The researcher also must keep the committee informed of the procedures and results. The USDA also makes several inspections of research facilities to identify possible violations. An annual report must be prepared by the appropriate committee regarding research it monitors. Reports are submitted to the USDA.

The ***Association of Official Analytical Chemists (AOAC)*** has been around for more than 100 years conducting research and sharing their tested research methods with others. The AOAC developed a methods manual to assist researchers in experiment planning and methodology. The AOAC manual contains approved methods of research for a variety of research purposes including plant, animal, and human. The methods have been studied, tested, and approved by the AOAC and meet the guidelines established by legislation for research.

CURRENT ISSUES IN FOOD SCIENCE RESEARCH

Biotechnology accounts for some advances in agriculture, medicine, food processing, and nutrition. Biotechnology refers to the combination of engineering and technology to study and find solutions to problems of living organisms. These advances share a common goal of making more quality and nutritionally efficient food available to consumers.

Agricultural advances have included improved irrigation methods that have allowed otherwise useless land to produce crops. Other advances include new types of farming called aquaculture and hydroponics discussed in Chapter Twenty-one. Hybrids (the offspring of two unlike species) and other plant forms created through genetic engineering have improved the quality and yields of various plants. New strains of plants are being created through crossbreeding. Recombinant DNA and cell fusion, two methods of altering genetic makeup, have unlimited possibilities.

Research is being conducted to genetically manipulate rice plants in order to improve their root penetration. In long periods of drought, the rice plant must rely on its root system to reach deeper into the soil to get water. Without enough water, the plant will weaken or die. Improving the root system of the plant allows it to survive during times of drought. This research is called plant stress biotechnology research. It combines molecular biology, genetics, and soil physics.

Genetic engineering has produced supercows (cows that can produce substantially greater amounts of milk than the average dairy cow) and superpigs (pigs that are much larger and produce more and leaner meat than the average pig) by transferring the knowledge learned from plant and soil science research to animal research. Future plants may be totally immune to disease. Research is being conducted to enable plants to resist herbicides naturally.

Food technology has led to improvements in the methods and results of food processing. Food nutrification programs have emerged, making the foods people eat more nutritious. At one time in the United States, iodine deficiency was a problem. Since 1924, iodine has been added to salt to eliminate iodine deficiency. In parts of South America, a vitamin A deficiency was discovered. Sugar was nutrified with vitamin A to help alleviate this diet deficiency. Research continues to discover better ways to package and market food products.

Nutrition research and medical research have determined that diseases interfere with a person's ability to absorb essential nutrients. Disease research and new forms of immunization have helped to eliminate some problems, but much more research is needed.

The field of food science and nutrition changes daily. Other issues in nutrition and food science not mentioned above include, but are not limited to, the following:
- the relationship between cholesterol and exercise
- the relationship between cholesterol and smoking and/or alcohol consumption
- the relationship between nutrition and cancer
- the relationship between food additives and good health

Current issues today may be solved or understood tomorrow. A person can be sure that other issues will develop and keep researchers and scientists challenged for years to come.

Summary

- Nutrition has not always been recognized as a contributing factor to disease. In the 1930s, scientists discovered that some diseases were a result of certain deficiencies in the diet.

- Genes are the basic hereditary units of all living things. Genetic engineering is a process by which scientists manipulate genes by introducing small amounts of foreign chemicals into the genetic makeup of an organism.

- Animals are used in many scientific studies to help scientists understand nutrition and to detect and cure various illnesses and diseases.

- Mice are the preferred animal for laboratory experiments because they have a fast gestation period and mature quickly.

- Legislation passed in the early 1970s established guidelines for animal research to ensure that research methods used were ethical and did not cause the animal any unnecessary pain. Enforcement for the legislation is conducted by the United States Department of Agriculture.

- The Association of Official Analytical Chemists developed a methods manual to assist researchers in their experiment planning and methodology.

- Biotechnology accounts for advances in agriculture, medicine, food processing, and nutrition. These advances share a common goal of making more quality and nutritionally efficient food available to consumers.

Vocabulary

Arabidopsis Thaliana
Association of Official Analytical Chemists (AOAC)
chromosomes
cytogenetics
genes

Review

1. What deficiency disease is caused by a lack of vitamin D?

2. How was animal research beneficial in finding a vaccination for small pox?

3. Why are chronic degenerative diseases a concern to food science and nutrition researchers?

4. How have plant and soil science studies benefited the cotton plant?

5. What affects the type of animal used in a research study?

6. Why are mice and rats used primarily in nutrition research?

7. What is the process for conducting research according to current legislation?

8. What is the AOAC and how is it beneficial to researchers?

9. What new developments in food science are results of genetic engineering?

10. What are four current issues related to food science and nutrition research?

Critical Thinking

Identify a current issue in food science or nutrition. Investigate the issue by visiting the school or local library or by contacting professionals. What research has been done on this issue? What were the findings? What conclusions can be drawn from the findings? What type of research is planned for the future? How can you benefit personally from the research being conducted on this issue?

23

Technology and Food and Nutrition

ESSENTIAL ELEMENT

- ❑ Discuss the effect of technology on food and nutrition and food supply, marketing, and distribution.(j4C)

OBJECTIVES

- ❑ Compare technological advances and their effects on the availability of foods.
- ❑ Interpret the use of marketing and market research in the field of food science and nutrition.
- ❑ Identify world food importing and exporting countries and their respective foods and food products.

Food science refers to the chemical and physical characteristics of foods. Nutrition refers to the quality of foods available for consumption. ***Food technology*** refers to the total sequence of food products from raw materials to production, processing, preservation, and distribution. This sequence is also known as the ***food production and distribution system***. Therefore, the field of food science and nutrition encompasses the entire food production system including processing and storage of foods as well as agricultural production and consumer purchases.

TECHNOLOGY AND AVAILABILITY OF FOODS

Technology has allowed individuals as well as countries to have more nutritious and greater varieties of food and food products. Technology has allowed for more international communication regarding growing, harvesting, and processing techniques as well as improvements in international trade. Agricultural knowledge and expertise are now being combined to provide better world food supplies.

Due to food technology and the availability of foods, food preservation has become a main focus of the food industry. Food scientists have become aware of the importance of not only preserving the food through improved methods of processing but also finding the best possible methods that also produce a minimum loss in nutrition.

Marketing has been affected greatly by advances in technology, especially in the United States. It is important to remember that with all of the advances in food technology and food processing, individuals still judge the quality of foods based on appearance, smell, and taste. Regardless of the nutritional value of a food product, it must have a pleasant appearance, smell, and taste before it will be accepted by the consumer. Nutrition, appearance, smell, and taste are considered as well as other factors including the following:

- acceptability
- availability
- convenience
- cost
- quality
- safety

Food technology takes all of these factors into consideration. Getting food and food products from their raw state to the consumer is a complex and often difficult process.

American Food Production and Distribution

The total output of agricultural products worldwide has increased consistently since the 1960s. In fact, world food production has risen slightly faster than the world's population. Despite the increase in world food production, there are still millions of people starving and millions that are undernourished.

Food production per capita is almost five times greater in developed countries than it is in developing countries. Developing countries have more difficulty growing crops because they are more vulnerable to crop disease and insect problems. Other difficulties include bad weather conditions, higher energy costs, and unreliable distribution systems. These factors also influence the food production per capita. Developed countries have a higher level of agricultural productivity and higher income levels. These factors allow developed countries to purchase and consume food products of higher levels such as meat, eggs, and milk.

Countries considered to be ***developing countries*** or those countries in the early stages of economic development include those in the following:

- Latin America (except Cuba)
- Greenland
- Africa (except Republic of South Africa)
- South Asia
- Southeast Asia (except Vietnam)

There are about 100 undeveloped countries in the world. Approximately seventy of these countries are new countries. ***New countries*** are countries formed since World War II. Some estimates show that these undeveloped countries account for approximately three-fourths of the world's population.

Countries considered to be developed countries include the following:

- Australia
- Canada
- Israel
- New Zealand
- Japan
- Republic of South Africa
- United States
- Western Europe

The American food production and distribution system, like the food production and distribution systems in most countries, begins when the soil is prepared for planting and ends when the final product is consumed. The stages between planting and consumption are very competitive in this country. Food production and distribution is a major industry in the United States. Stages of the American food production and distribution system include the following:

- food, nutrition, and agricultural research
- plant and animal research
- agricultural production

- processing plants
- food product packaging and labeling
- transportation and storage
- marketing
- distribution
- retail food markets

A seed planted for agricultural production today is often one that has undergone substantial research. The seed has probably been genetically engineered to produce a high yield, to have maximum nutritional qualities, and to have an above average immunity to drought and other potential natural disasters. Many have an immunity to certain herbicides. The soil must be properly irrigated and fertilized to produce the maximum crops.

Once the crop has been harvested, it must be processed and preserved. Processing and preservation can incorporate the now traditional canning, freezing, dehydration, or individually quick frozen (IQF) processes. The product may face technological advances in processing and be processed through one of the following methods:

- aseptic processing
- extrusion
- fermentation
- microwave processing
- retort pouches
- vacuum packaging

For more information on food processing, refer to Chapter Eight.

The distribution process begins when the finished product is transported to major warehouse outlets. The warehouse outlets' trucks deliver the product to the local food service retailer (grocer, restaurant, or institutional food establishment). The food service retailer sells the product to the consumer.

Another method of distribution is called the ***direct store delivery (DSD)***. The DSD process involves the product being purchased by a distributor from the major manufacturer. The distributor has its own fleet of trucks. Representatives from the distributor call on the retail outlet. Once an order is placed, the distributor delivers the food product to the food service retailer.

Grocery store shelf space is very costly in the United States. With the millions of products available for placement on grocery store shelves, the competition for shelf space and consumer purchasing is very strong. Thousands of dollars are paid to get a particular product on a grocer's shelf in the preferred location. The marketing of American food products is discussed later in the chapter.

The American food distribution system differs from that of other countries for several reasons. The United States has better equipment for planting, harvesting, processing, and distributing food and food products. More updated technology for agricultural products and computers and the increased use of automation makes it substantially different from many other systems.

Technology introduced the use of the Universal Product Code (UPC). The UPC is a bar code with numbers that is placed on the packages of food products. The bar code is easily read by a computer and is used for checking foods into and out of manufacturers' shipping rooms, distributor warehouses, and retail food sources. Cashiers at grocery stores use special cash registers and equipment to scan the UPC. Once scanned, an item is listed on the receipt by name, weight or type, and price. This process itemizes and totals customers' grocery purchases. It is faster and less expensive, and it allows for fewer mistakes than manual methods.

1 0

1 2 3 4 5 6 7 8 9 0

UPC

Breakdowns in the food production and distribution system in the United States are generally localized. For example, if a crop is lost in Texas, it primarily affects Texas rather than the country as a whole. If a crop of citrus fruits were lost in Texas, the fruit could be purchased from Florida then transported and distributed in Texas. The final cost may be higher, but the product would still be available. A problem with food distribution such as this would affect major metropolitan areas first because of the larger population and larger numbers of purchases and demands for the product.

Artificial and Synthetic Foods

Synthetic foods have made an impact on the preservation and processing of foods. Synthetic foods are made by a process that manipulates food materials. Carbohydrates, fats, proteins, and vitamins used in artificial or synthetic foods are often made from microorganisms. Chemical conversions are usually involved. These synthetic foods can be made by spinning plant proteins and other ingredients into fiberlike structures. Synthetic bacon, beef, and poultry can be made in this manner. Synthetic crab, lobster, and beef analogues have increased in popularity. For more information on artificial and synthetic foods, refer to Chapter Eight.

MARKETING AND MARKET RESEARCH

Marketing refers to the process involved in moving food and food products from the producer to the consumer. It combines product, price, place, and promotion. Marketing incorporates determining the potential customers and their wants and needs. It involves purchasing products to satisfy those needs and wants and getting the merchandise into the customer's possession. It also involves executing a sales idea, pricing the merchandise, and promoting it. The primary objective of marketing is to help businesses make a profit while providing customers with goods or services that satisfy their needs and wants.

Marketing is an ongoing project of any food-related business. Consumer habits, tastes, wants, and needs vary seasonally and sometimes yearly. The process involves analysis, planning, execution, reviewing, and more planning. Experience and judgement play an important role in any marketing program. Customer habits, tastes, and needs as well as the merchandise available, vary from location to location and often from year to year. The decision to use any or all marketing techniques mentioned requires experience and judgement. In order to be successful, a business' marketing program must be constantly reevaluated.

Wholesalers play an important role in the marketing of foods and food products. ***Wholesalers*** buy from growers or processors and sell to retail food markets. Thus, they are in a position to remain informed about product availability and price fluctuations from growers or producers and they learn about consumer wants and needs from the retail food markets.

Food brokers sell food for a manufacturer but never take actual possession of the food as a wholesaler does. Food brokers are independent and receive a certain dollar percentage of the products sold.

The wholesaler or food broker gives the retail food markets information about the market and about ways to satisfy customer wants and needs. The wholesaler or food broker can usually predict local consumer spending habits by events that take place nationally or geographically. Current information about consumer demand, supply availability, prices, and new trends or developments in the industry can be supplied by the wholesaler or food broker.

Wholesalers and food brokers learn from retail food markets which items consumers have been purchasing and which items have not attracted attention. Wholesalers and food brokers are able to advise retail food markets about shifts in product demands, product supply, and prices so that retail food markets can adjust their purchasing accordingly. This type of information is important for retail food markets because it allows them to make smart, profitable purchases. A wholesaler or food broker can give food service retailers this information in various ways. They may inform sales personnel, provide newsletters or other publications, or communicate directly with food service retailers.

In addition to information about market conditions and product supply, wholesalers and food brokers often give retail food markets suggestions for improving the sale of particular products or ideas for displaying products. The wholesaler and food brokers are usually informed about new trends and about certain selling or merchandising techniques that have been successful for other retail food markets. Wholesalers, food brokers, producers, growers, processors, and retail food markets should exchange information about the industry because they all benefit from each other's successes. Figure 23.1 identifies ways to market a product.

Ways To Market A Product

- Through the choice of name for the product
- By developing a product that is very convenient or that has high utility
- By packaging that is appealing in form and color
- Through labeling that is informative and readable
- By pricing the product so that it competes successfully with other brands
- By conducting marketing surveys and planning a strategy for introducing the product to the market
- Through an effective advertising campaign

Figure 23.1

Advertising

Advertising is the action of favorably presenting goods for sale to the public using paid announcements publicized or broadcast by the media. It is a communication process, a marketing process, and an economic or social process that is directed to groups of people instead of individuals. Most advertising reaches the consumer through newspapers, television, radio, billboards, and the mail. More subtle methods of advertising reach the consumer through the marketing of store and window displays, services offered by the store, and employees. Advertising's primary purpose is to inform, persuade, and remind customers of particular products and services. Advertising is used to encourage consumers to purchase merchandise.

Advertising can be accomplished through a variety of media. The one selected depends on the business, the product or products to be advertised, and local customs and expectations. The six basic categories of advertising are national advertising, local advertising, direct marketing advertising, trade advertising, industrial advertising, and professional advertising.

National advertising is also known as brand-name advertising. The emphasis is placed on a specific product instead of a place where the product can be purchased. Examples include a specific brand of chicken, frozen dinner, or mayonnaise. The price is typically not mentioned in this type of advertising. National advertising is commonly found in magazines, on radio and television, and occasionally in newspapers.

In local advertising, which is produced and used locally, the price is always mentioned because its purpose is to get customers into particular stores. ***Local advertising*** appears in newspapers, on radio and television, and occasionally in regional editions of national magazines. Information may include weekly specials, new products, or coupons for particular items.

Direct marketing advertising also is referred to as direct mail advertising. Examples include coupon packages or free samples of new products that are delivered through the mail to the consumer.

Trade advertising is directed toward retail food markets, wholesalers, and brokers. This also may be referred to as business to business advertising. Grocers, wholesalers, and brokers are the producer's customers. This advertising stresses the benefits of the product and the potential profits that can be made as a result of stocking and selling a particular item.

Industrial advertising is directed toward processors. Processors purchase raw materials and machinery for use in the production process. This advertising is placed in trade magazines and is sent by direct mail advertising methods.

Professional advertising is directed to physicians, dietitians, and other professionals who help direct or recommend various products to others. This type of advertising stresses the benefits of the product rather than the profits to be made. The ads appear in professional and trade magazines, through actual samples of the product, and through direct mail.

Research Tools

Market research is an integral part of the American marketing system. It enables producers, distributors, and retailers to gear their marketing plans to meet the wants and needs of their target customers. Market research uses various survey techniques or tools to identify the following:

- consumer incomes
- consumer habits
- occupation(s) of household members
- consumer buying habits
- household size
- ages of heads of households
- education levels

Research tools include market surveys, company records regarding past purchasing, telephone surveys, and mail surveys. Large producers can determine what products sell in various parts of the country as well as what percentage of consumers purchase particular brands of products. Table 23.1 illustrates a sample of some of the categories of questions asked and results received in a marketing survey.

Sample Marketing Survey Results

	Distribution of Households Surveyed	Total Households That Use the Product	Households That Use Brand A	Households That Use Brand B	Households That Use Brand C
Income of Household					
Less than $12,000	20 %	104	89	64	62
$12,000-$19,999	18	96	94	132	84
$20,000-$24,999	14	103	101	93	75
$25,000-$29,999	10	115	113	76	51
$30,000-$39,999	16	103	114	137	94
$40,000 or more	22	95	99	96	187
Occupation of Male Head					
Professional	29 %	96	91	115	180
White Collar	9	84	98	160	72
Blue Collar	33	113	110	72	55
Not in Work Force	29	95	101	95	95
Occupation of Female Head					
Professional	22 %	86	86	91	110
White Collar	40	79	76	52	71
Blue Collar	18	99	98	155	165
Not in Work Force	20	115	114	102	91
Household Size					
1-2 Members	45 %	76	86	92	97
3-4 Members	41	121	113	105	84
5 or more Members	14	164	140	120	160
Education of Female Head					
Not High School Graduate	10.5 %	118	90	105	68
High School Graduate	40	110	118	94	80
Some College	26	91	94	75	170
College Graduate	29.5	93	86	145	90
Education of Male Head					
Not High School Graduate	9 %	116	88	106	66
High School Graduate	39.8	107	115	96	82
Some College	21.2	90	93	72	150
College Graduate	30	93	87	140	93

Table 23.1

Cost

The cost of advertising and marketing products can incorporate as much as 40 percent of the final product cost. This cost includes research, product testing, packaging, labeling, distribution, and other costs related to getting the product from the producer to the consumer. The money spent on advertising and marketing also has been used to educate the public about new research and progress in the field of food science and nutrition. Consider the many cereal advertisements that have made the public aware of the need for fiber to decrease the chance of colon cancer or the use of certain cooking oils to lower cholesterol intake. Negative advertising normally includes what a product does not have such as no preservatives, no cholesterol, and low sugar. The advertisements or packaging may be enough to entice individuals into purchasing a particular product that they would not normally purchase.

Figure 23.2 illustrates the amount of each dollar spent on food that pays for transportation, wholesaling, retailing, processing, food service, and farm value(amount that goes to the farmer). The amounts spent to pay for food eaten at and away from home are shown.

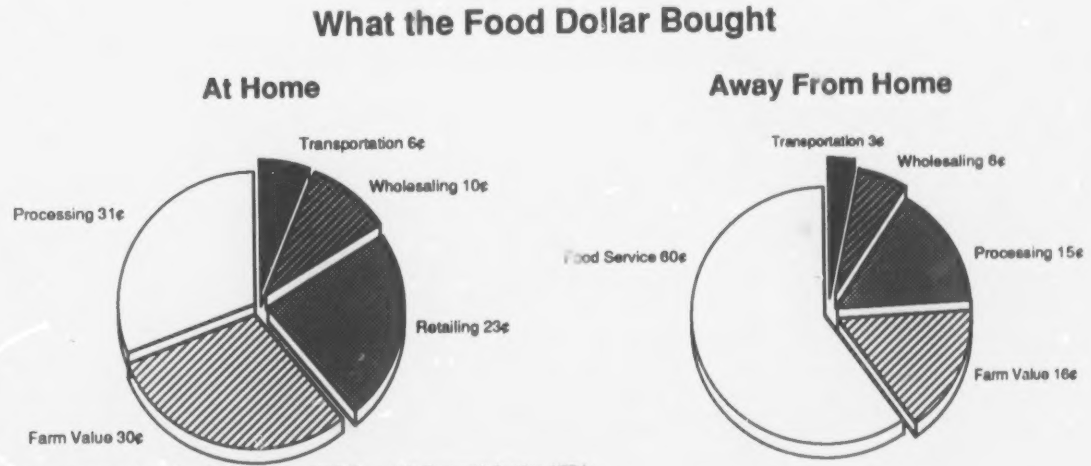
WORLD FOOD DISTRIBUTION

The effects of technology on food and nutrition and food supply, marketing, and distribution has had a substantial impact on world food distribution. Without technology, international trade would not be possible. Importing and exporting food and food products has become a worldwide industry due to technology. Importing refers to purchasing or receiving products from other countries. Exporting refers to selling or sending products to other countries (importing countries). An exporting country is one that offers products to other countries primarily for sale.

Currently, less than ten countries around the world have any substantial food export capabilities. Some of these countries are included in the following:

- Australia
- Canada
- some European countries
- New Zealand
- some South American countries
- Soviet Union
- United States

It is estimated that only 10 percent of any country's food products are exported to other



Source: Denis Dunham, Food Cost Review, 1989, Economic Research Service, USDA

Figure 23.2

nations. Ninety percent of a country's food production is used in the country where it is produced.

The United States has increased agricultural imports in recent years. The origins of agricultural imports to the United States are included in table 23.2 The primary agricultural products imported by the United States include the following:

- coffee and coffee products
- meat and meat products
- fruits and vegetables
- nuts

United States Imports

Continent/ Country/Area	Countries or Areas Included	Agricultural or Animal Product Exported
Africa	Egypt, Tunisia, Morocco, Sudan, Cameroon, Ivory Coast, Central African Republic, Burundi, Ethiopia, Uganda, Kenya, Tanzania, Algeria, and Malawi	cereals and cotton
Asia	Cypress, Syria, Lebanon, Israel, United Arab Emirates, Yemen, India, Sri Lanka, Japan, China, Thailand, Laos, Malaysia, Singapore, Indonesia, Philippines, South Korea, Hong Kong, and Taiwan	cereals (wheat, barley, corn, rice), cotton, and livestock
Canada		cereals (wheat, barley, oats), dairy products, fruits, and vegetables
Caribbean	Bahamas, Jamaica, Cayman Islands, Haiti, Dominican Republic, Barbados, and Leeward and Windward Islands	tobacco, fruit, and livestock
Central America	Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, and Panama	corn
Mexico		wheat, corn, and cotton
Oceania	Islands in the Pacific including New Zealand, Australia, and Papua New Guinea	cereals, dairy products, and fruit
South America	Colombia, Venezuela, Ecuador, Peru, Bolivia, Brazil, Paraguay, and Argentina	cereals (oats and wheat), coffee, cocoa, and grapes and other fruit
Western Europe	Denmark, the United Kingdom, Ireland, the Netherlands, Belgium, Luxembourg, France, Germany, Spain, Portugal, Italy, Greece, Iceland, Sweden, Norway, Finland, Austria, and Switzerland	cereals (wheat, corn, and rice), dairy products, cattle, hogs, potatoes, sugar beets, grapes, fruit, wine, nuts, and olives

Source: *Foreign Agricultural Trade of the United States (FATUS)*, Washington, D.C., United States Department of Agriculture, Economic Research Service, 1989, pp. 311-381.

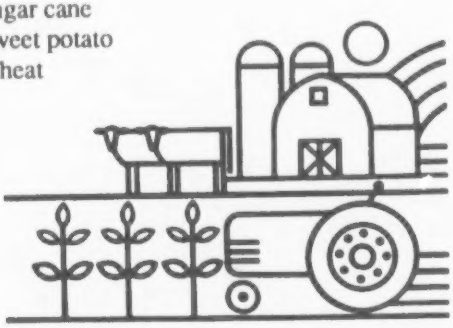
Table 23.2

- cocoa and its byproducts
- sugar
- wine and beer
- oils of seeds and their byproducts
- unmanufactured tobacco
- bananas

World Food Exports

The majority of the world's food supply comes from about fifteen different plants. The plants include the following:

- banana
- cassava (an American tropical plant, tree, or shrub with edible starchy roots. The starch extracted from it is used for making bread and tapioca.)
- coconut
- corn
- legumes
- peanut
- potato
- rice
- sorghum
- soybean
- sugar beets
- sugar cane
- sweet potato
- wheat



Three-fourths of the cultivated acres in the world are planted with cereal grains. The cereal grains include rice, wheat, corn, sorghum, and barley. Five countries or regions, including the United States, provide more than half of the total cereal grain production. Other countries include the Soviet Union, China, Western Europe, and Eastern Europe. The United States produces approximately 20 percent of the world's grain, making it the largest producer. China and the Soviet Union follow the United States in cereal grain production.

The United States also is the leading producer of coarse grains including the following:

- barley
- corn
- grain sorghum
- millet
- oats
- rye

The Soviet Union and China follow the United States in coarse grain production. However, the United States still exports a significant amount of grains to both the Soviet Union and China.

The Soviet Union is the leading producer of wheat. The Soviet Union is followed by the United States, China, and India in wheat production. The Netherlands and Denmark also produce substantial amounts of wheat. Wheat is primarily grown and consumed in the areas in which it is produced.

China is the leading producer of rice followed by India and Bangladesh. These three countries are also the leading consumers of rice in the world. Japan and Jamaica also produce a significant amount of rice.

Approximately half of the world's corn production occurs in the United States. Other countries that are large corn producers include Brazil, China, and Yugoslavia. Austria and New Zealand are also corn producing countries.

Soybeans and their byproducts are used quite extensively in the United States. They are good sources of protein. Soybeans and other beans serve as the main protein sources for many countries. The United States is the largest producer of soybeans with two-thirds of the world's production. Brazil and China rank second and third. Bean production is highest in China, followed by India, Mexico, Central America, South America, and the West Indies.

Potatoes are a chief energy source in many countries. Potato production is greatest in the Soviet Union and the European countries. The

Soviet Union produces the largest amount followed by Poland and Germany. The United States produces approximately 7 percent of the world's potato crops.

Sugar cane and sugar beets are used to produce sugar. Sugar cane is usually grown in tropical areas of the world while sugar beets are grown in more moderate temperatures. Sugar cane is produced primarily in Brazil, Cuba, and India. The Soviet Union is the major producer of sugar beets followed by the United States and several European countries. Sugar production—including both sugar cane and sugar beets—takes place in the following countries in descending order:

- European Economic Community
- Brazil
- Soviet Union
- India
- Cuba
- United States
- Australia
- Mexico
- China

Cotton is grown in many countries around the world with the United States growing approximately 25 percent. Cotton is used for its fiber qualities as well as for the oil of its seeds. Oil makes up 15 to 20 percent of the cottonseed. Leading cotton producing countries other than the United States include the Soviet Union and India.

Livestock and poultry are major sources of food, especially in developed countries. Animal protein consumption increases as income and purchasing power increases. Cattle are used most often for meat consumption, providing beef, veal, butter, cheese, milk, and leather. Sixty percent of the world's supply is produced by the United States, the Soviet Union, and the European Economic Community countries. These countries combined contain only about 17 percent of the world's population.

Poultry has become an important item in world food production. Many developing countries have adopted techniques for egg and chicken production from developed countries. The Soviet Union, the United States, and Japan are the leading poultry producing countries. These countries are followed by Poland, Germany, France, the United Kingdom, Italy, Turkey, and Spain.

Figure 23.3 lists various livestock and the countries that produce them. They are listed in descending order of volume produced.

The Soviet Union produces the largest amount of milk per year in the world. The Soviet Union is followed by the United States and France in milk production. Other leading milk producing countries include India, Germany, Poland, the United Kingdom, the Netherlands, Italy, and Brazil. The United States relies heavily on cows for milk production. Many areas of the world rely on goats and sheep for milk production.

Livestock Production

Cattle and Buffalo
India
Soviet Union
United States
China
Brazil
Argentina
Mexico
Australia
France
Turkey
Germany
Canada

Hogs
China
Soviet Union
United States
Brazil
Germany
Poland
Mexico
France
Romania
India
Denmark

Sheep
Soviet Union
Australia
China
New Zealand
Turkey
India
Argentina
Iran
South Africa
United Kingdom
Brazil
United States

Fish
Japan
Soviet Union
China
United States
Peru
Norway
India
Korea
Thailand
Denmark

Source: *Foreign Agricultural Trade of the United States (FATUS)*, Washington, D.C., United States Department of Agriculture, Economic Research Service, 1989, pp. 311-381.

Figure 23.3

United States Exports and Imports

The United States is one of the largest exporting countries of agricultural products in the world. Almost one-third of the United States' agricultural production is exported. Asia—including China, South Asia, Korea, West Asia, and Japan—and Western Europe are the leading importers of farm products from the United States. Asia and Western Europe are followed by the Soviet Union and Eastern Europe, Mexico, Brazil, the Caribbean, Venezuela, Canada, and Africa. Products exported include the following:

- grains and preparations
- oil of seeds and their byproducts
- livestock and their byproducts
- cotton
- fruits
- vegetables
- nuts

Several government agencies are essential in the exportation of American agricultural products. The ***Foreign Agricultural Service (FAS)*** is a government service and promotion agency for American agriculture. The service covers seven areas of exporting American agricultural products. The seven areas include the following:

1. Maintaining and expanding agricultural exports
2. Improving access to foreign markets
3. Facilitating a global analysis and reporting network
4. Implementing the Food for Peace Program
5. Formulating and administering the Commodity Credit Corporation and the FAS export program
6. Servicing United States consumers
7. Administering a system of import quotas

The ***Export Marketing Service*** is designated to promote and assist in export sales of farm products produced in the United States and to expand export sales. Even though the United States is the largest exporting country, it also is a major importing country of foods and food products. Refer to Chapter Seven for more information on world food trade policies.

Some of the products imported by the United States are listed in table 23.3. The countries from which the United States imports the majority of the products also are listed.

Transportation

Computers are used throughout the industry and will play a more important role in all segments of the industry in the future. The food industries of the United States and many other developed countries are largely computerized. Computers assist in all phases of the food production and distribution system from determining the best time to plant crops to determining demographics and consumption patterns of various parts of the world. Computers are used to place orders, determine inventory, receive products, and improve food delivery techniques.

Importing and exporting has increased the food available for consumption in the United States and has increased foods available for the world food supply. Technological advances in communication devices such as telephones, facsimile machines, radar, satellite, television, and computers have improved communications between countries.

There is often a significant difference between domestic and imported food and food products. The difference seems to be in selection and quality. With improved technology in growing techniques, expanding markets, and improved shipping and transportation methods, almost any food is available at any time of the year in any part of the world. These foods easily can be imported or exported to meet consumer demands and to expand product availability.

EXPORTS IMPORTS EXPORTS IMPORTS

Products Imported by the United States

Product	Countries of Origin
Bananas	Approximately 35 countries including Ecuador, Costa Rica, Honduras, Colombia, Panama, Mexico
Coffee	Approximately 95 countries including Brazil, Mexico, Guatemala, Colombia, Ecuador, Germany, India, Indonesia, Thailand, Ethiopia, Uganda
Cocoa	Approximately 80 countries including Brazil, Ivory Coast, Ecuador, Dominican Republic, Netherlands, Nigeria, Malaysia, Indonesia, Singapore
Tea	Approximately 80 countries including China, Argentina, Indonesia, Germany, Sri Lanka, India, Kenya
Butter and butterfat mixtures	Approximately 15 countries including Ireland, New Zealand, France, Denmark
Cheese	Approximately 50 countries including Italy, New Zealand, Netherlands, Denmark, France, Norway, Finland, Austria, Australia, Switzerland
Wheat	Approximately 8 countries including Canada, Australia
Corn	Approximately 18 countries including Argentina, Canada, France, Mexico
Oats	Approximately 17 countries including Canada, Sweden, Finland, Argentina
Barley	Approximately 15 countries including Canada, New Zealand, Argentina
Rice	Approximately 25 countries including Thailand, India, Brazil, China, Pakistan
Strawberries	Approximately 20 countries including Mexico, Poland, Guatemala
Apples	Approximately 12 countries including Canada, Chile, New Zealand, Argentina
Citrus	Approximately 25 countries including Mexico, Bahamas, Spain, Japan, Israel
Grapes	Approximately 10 countries including Chile, Mexico
Mangoes	Approximately 10 countries including Mexico, Haiti
Melons	Approximately 30 countries including Mexico, Honduras, Costa Rica, Dominican Republic, Guatemala, Panama
Pineapples	Approximately 15 countries including Honduras, Dominican Republic, Mexico, Southeast Asia
Sugar (beets and cane)	Approximately 35 countries including Australia, Africa, Philippines, Thailand, China, Papua New Guinea, India
Meats and meat products	Approximately 65 countries including Canada, Australia, New Zealand, Poland, Yugoslavia, Sweden, Guatemala, Costa Rica, Denmark, Argentina, Brazil, Dominican Republic

Source: *Foreign Agricultural Trade of the United States (FATUS)*, Washington, D.C., United States Department of Agriculture, Economic Research Service, 1989, pp. 311-381.

Table 23.3

Summary

- ☐ Food technology involves all aspects of getting food and food products from their raw state to the consumer.
- ☐ The total output of agricultural products worldwide has increased consistently since the 1960s. In fact, world food production has increased slightly faster than the world population.
- ☐ Developing countries have more difficulty growing crops because they are more vulnerable to crop disease and insect problems as well as bad weather conditions, higher energy costs, and unreliable distribution systems.
- ☐ Grocery store shelf space is very costly in the United States with thousands of dollars being paid to get a particular product on a grocer's shelf.
- ☐ Marketing incorporates determining the potential customers and their wants and needs.
- ☐ Advertising is a communication process, a marketing process, and an economic or social process that is directed to groups of people instead of individuals.
- ☐ Currently, less than ten countries around the world have any substantial food export capabilities.
- ☐ Three-fourths of the cultivated acres in the world are planted with cereal grains. The cereal grains include rice, wheat, corn, sorghum, and barley.
- ☐ The Soviet Union is the leading producer of wheat followed by the United States, China, and India.
- ☐ The United States is the largest producer of soybeans with two-thirds of the world's production. Brazil and China rank second and third.
- ☐ Cotton is grown in many countries around the world. The United States grows approximately 25 percent of the world's production.
- ☐ The Soviet Union produces the largest amount of milk per year followed by the United States and France.
- ☐ The United States is probably the largest exporting country of agricultural products in the world. Almost one-third of the United States' agricultural production is exported.
- ☐ Even though the United States is the largest exporting country, it is also a major importing country of foods and food products.

- With improved technology in growing techniques, expanding markets, and improved shipping and transportation, almost any food is available at any time of the year in any part of the world to meet consumer demands.

Vocabulary

advertising
developing countries
direct marketing advertising
direct store delivery (DSD)
Export Marketing Service
food brokers
food production and distribution system
food technology
Foreign Agricultural Service (FAS)
industrial advertising
local advertising
marketing
national advertising
new countries
professional advertising
trade advertising
wholesalers

Review

1. What factors do consumers consider when making food selections?
2. Identify five countries that are considered to be developed countries.
3. What are the stages of the food production and distribution system?
4. How do marketing and advertising differ?
5. In what ways do advertising and marketing affect the price of food products?
6. What products are typically imported by the United States?
7. What countries are the major producers of corn?
8. What countries are the major producers of sugar?
9. What country is the world leader in potato production?
10. In what ways are the Foreign Agricultural Service and the Export Marketing Service beneficial to agriculture production?

Critical Thinking

Interview a local USDA representative and discuss crops grown locally. Ask the representative what happens to the crops once they are harvested? To whom are the crops sold? Are they sold to other states or countries? For how much does the product sell? How does the crop production influence the local economy? What would happen if all or part of the crop production were damaged?

Create a product and develop a marketing plan. The plan should include market research strategies and advertising. Include information regarding distribution and pricing. Who will benefit from the use of this product? What sources (wholesalers or food brokers) must one have to develop the product?

24

Reliable Nutrition Information

ESSENTIAL ELEMENT

- ☐ Propose ways to disseminate and use reliable nutrition information.(j4D)

OBJECTIVES

- ☐ Compare the various divisions of the United States Department of Agriculture and the nutrition information available from them.
- ☐ Describe the benefits of programs that are directed by the United States Department of Health and Human Services.
- ☐ Evaluate a variety of resources that provide reliable nutrition information to the general public.

A variety of resources are available to provide reliable nutrition information. A ***resource*** is a person or thing that can help someone else. Examples of resources include energy, money, time, skills, and information. Information is the key to making the most of a person's available resources. Information is an important resource for understanding nutrition. There are good and bad resources for information. Sometimes it is difficult to determine which sources are reliable and which are not.

Some reliable resources pertaining to food science and nutrition include information from the following organizations:

- Food and Drug Administration
- professional journals
- Texas Department of Health and Human Services
- Texas Agricultural Extension Service
- United States Department of Agriculture
- media distribution
- educational programs including classroom instruction and textbooks
- professionals

UNITED STATES DEPARTMENT OF AGRICULTURE

The United States Department of Agriculture (USDA) is a very large organization with many agencies. Each agency has its own area of expertise and readily disseminates information related to food science and nutrition. The various agencies of the USDA and a brief description of their responsibilities are included below.

Economics

- **Economics Research Service (ERS)** – This agency conducts research in domestic and foreign agricultural economics. The ERS also analyzes factors that affect agriculture, farm productivity, financing, the use of resources, and the potentials of rural areas. It evaluates marketing potentials and development and marketing costs. The ERS studies United States trade in agricultural products and the role of agriculture in the economic development of other nations.

- **National Agricultural Statistics Service** – This agency prepares the official USDA data and estimates of production, prices, and other necessary information to maintain agricultural operations through periodic reports made to the public.

- **World Agricultural Outlook Board** – This agency coordinates the USDA's supply and use commodity forecasts and agricultural situation and outlook analyses. The department also coordinates the annual Outlook Conference.

- **Office of Energy** – This office coordinates the USDA's energy policy. The policy includes all issues dealing with agricultural energy use and agricultural impacts of energy development and use.

Food and Consumer Services

- **Food and Nutrition Service** – This agency administers federal food assistance programs including food stamps; food distribution; supplemental food for women, infants, and children; school lunch and breakfast programs; child care; and summer feeding as well as other child nutrition and family food assistance programs.

- **Human Nutrition Information Service** – This agency measures food consumption and dietary levels of the population and develops standard reference tables on the nutritional values of foods. It also develops and cooperates with other agencies in the development of materials to aid the public in meeting dietary needs with emphasis on good nutrition, appropriate cost, palatability, safety, avoidance of food waste, and energy conservation.

- **Office of Consumer Advisor** – This office coordinates USDA actions on problems and issues of importance to consumers. It represents the USDA in policy discussions related to consumer issues before Congress, with other departments and agencies, and in various public forums.

International Affairs and Commodity Programs

- **Agricultural Stabilization and Conservation Service (ASCS)** – This agency administers commodity production adjustment and support programs, conservation cost-sharing with farmers and ranchers, the Conservation Reserve Program, natural disaster assistance to agricultural producers through payments and cost-sharing, and certain national emergency preparedness activities.

- **Foreign Agricultural Service** – This agency serves as a basic source of information to people involved in agriculture in the U.S. on world crops, policies, and markets. It administers agricultural import regulations, assists in the export of U.S. farm products, represents U.S. agriculture in foreign trade matters, and reports export sales.

- **Office of International Cooperation and Development** – This office coordinates USDA's international training and technical assistance programs. It sponsors international research projects and scientific and technical exchanges with other nations on topics of interest to U.S. farmers and agribusinesses. The agency's work includes development planning, analysis, and efforts to encourage private agribusinesses to get involved in development work overseas. The agency also serves as USDA's liaison with international food and agriculture organizations.

Marketing and Inspection Services

- **Agricultural Cooperative Service** – This service provides research, management, and educational assistance to cooperatives to strengthen the economic position of farmers and other rural residents. It works directly with cooperative leaders and federal and state agencies to improve organization, leadership, and operation of cooperatives and to give guidance to further development.

- **Agricultural Marketing Service** – This agency provides for market news; develops quality grade standards; and provides voluntary grading services for meat, poultry, eggs, dairy products, fruits and vegetables, cotton, tobacco, and livestock; administers marketing regulatory programs, marketing agreements and orders, and research and promotion orders; administers for federal and state marketing improvement programs and wholesale facilities research programs; and purchases foods for USDA food assistance programs.

- **Animal and Plant Health Inspection Service** – This agency administers regulatory programs to control or eradicate animal and plant pests and diseases; to enforce domestic and port-of-entry agricultural quarantine; to license and assure the safety and effectiveness of veterinary biological products; to enforce the Animal Welfare and Horse Protection Acts; and to provide protection to livestock and crops from depredation by rodents, birds, and predatory animals.

- **Federal Grain Inspection Service** – This agency inspects and weighs grain and commodities; supervises official, private, and state grain inspection agencies; and maintains U.S. grade standards for grain and grain products.

- **Food Safety and Inspection Service** – This agency administers the federal meat and poultry inspection program to assure safety, wholesomeness, and truthful labeling of these products. It also conducts the food safety consumer education program.

- **Office of Transportation** – This office provides services and conducts research activities of the department relating to the transportation of farm products, commodities, inputs, and equipment to help farm income, expand exports, and meet the needs of rural America.

- **Packers and Stockyards Administration** – This agency enforces the Packers and Stockyards Act, an antitrust fair trade practice and payment protection law designed to assure free and open competition and to prevent unfair and deceptive practices in the marketing of livestock, meat, and poultry.

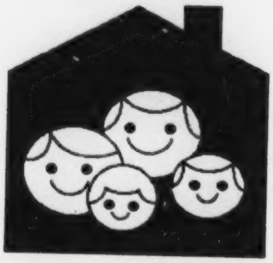
Small Community and Rural Development

- **Forest Services** – This service administers programs for applying sound conservation and utilization practices to natural resources for the national forests and national grasslands; for promoting these practices on all forest lands through cooperation with states and private landowners; and for carrying out extensive forest and range research.

- **Soil Conservation Service** – This agency carries out a national soil and water conservation program with cooperation of landowners and operators in local soil and water conservation districts and with other government agencies; administers the department's Great Plains conservation program and watershed protection and flood prevention program; leads the national cooperative soil survey; conducts departmental leadership in assisting landowners and local groups in resource conservation and development projects.

Small Community and Rural Development

- **Farmers Home Administration** – This office provides loans to farmers who cannot obtain credit from banks or other lending institutions. It makes loans for single-family housing and multi-family housing in rural areas and to small communities to help them provide clean water, waste water treatment, health clinics, fire equipment, and other community facilities. It guarantees loans for businesses and industries in rural areas to help create jobs and maintain economic stability.



- **Federal Crop Insurance Corporation** – This agency insures farmers against value of lost crop production due to natural disasters such as hail, fire, and drought.

- **Rural Electrification Administration (REA)** – This office makes and guarantees loans to rural electric and telephone systems to provide service at affordable cost. It makes zero interest funding available to REA borrowers for rural economic development and job creation.

Science and Education

- **Agricultural Research Service** – This agency conducts research on production of animals and plants; protection of animals and plants from diseases; use and improvement of soil, water, and air resources; processing, storage and safety of food; and human nutrition.

- **Cooperative State Research Service** – This agency administers certain federal funds appropriated for agricultural and forestry research at state agricultural experiment stations, forestry schools, 1,890 universities, and selected veterinary schools. It helps coordinate regional and national research planning. It conducts competitive and special research grant programs and maintains the Current Research Information System (CRIS) of state and federal research records for publicly supported agricultural and forestry research.

- **Extension Service** – This office links research, science, and technology to the needs of people where they live and work by providing practical education and information. It is the federal partner in the Cooperative Extension System networking seventy-four land grant universities and local offices in more than 3,100 counties. Land grant universities are those that were established by federal funds to teach agriculture and home economics.

- **National Agricultural Library** – This agency provides technical information on agricultural research and related subjects to scientists, educators, and farmers. It is the coordinator and primary resource for national network of state land grant and field libraries. The library serves as the U.S. center for international agriculture information system.

- **Office of Budget and Program Analysis** – This office provides direction and administration of the department's budgetary functions; evaluates program and legislative proposals for program, budget, and related resources implications; analyzes program and resource issues and alternatives; and prepares summaries of pertinent data to aid departmental policy officials and agency program managers in the decision-making process. This agency also provides department-wide coordination for and participation in the presentation of budget-related matters to the committees of Congress, the press, and interested public. It provides department-wide coordination of the preparation and processing of legislative programs and reports.

- **Office of Inspector General** – This office conducts and supervises audits and investigations relating to the department's programs and operation. It provides leadership and coordination and recommends policies for activities designed to prevent and detect fraud and abuse and to promote economy, efficiency, and effectiveness in departmental programs. The office administers departmental programs, operations, and actions designed to correct such problems and deficiencies.

- **Office of the General Counsel** – This office provides legal counsel and services to the secretary and department agencies.

Administration

- **Office of Advocacy and Enterprise** – This office provides leadership, direction, and coordination for the department's programs for civil rights, equal employment opportunities, small and disadvantaged businesses, minority research and teaching, and competition advocacy.

- **Office of Finance and Management** – This agency provides direction, leadership, and coordination of programs in finance, accounting, federal assistance, occupational safety and health, productivity, management improvement, and administrative systems. It oversees the activities of the National Finance Center and fulfills the comptrollership function of the Working Capital Fund. It also provides budget, accounting, and fiscal services to the Departmental Staff Offices and the Office of the Secretary.

- **Office of Information Resources Management** – This office develops, recommends, and disseminates departmental information resources management principles, policies, standards, guidelines, and regulations. It designs, develops, approves, implements, and reviews systems, processes, work methods, and techniques to improve the management of information resources and the operational effectiveness of USDA. It also provides telecommunications services to USDA agencies and staff offices.

- **Office of Operations** – This office provides overall general direction, leadership, and coordination of real and personal property, procurement, and mail functions and operates certain consolidated administrative activities in the department.

- **Office of Personnel** – This office provides leadership and coordination of the Personnel Management Program of the department and the evaluation of the effectiveness of agency personnel programs.

Texas Agricultural Extension Service

The ***Texas Agricultural Extension Service (TAES)*** is a division of the Science and Education branch of the USDA. It is basically divided into two sections: agriculture and home economics. It is part of the Texas A&M University System.

Home economists are hired by the extension service to teach subjects related to foods and nutrition in addition to other home economics subject areas. Instruction is provided in formal settings such as classrooms and informal settings such as community buildings and homes. Radio and television programs also may be presented. Newsletter series and direct mail information are provided by some extension offices. A variety of free and inexpensive publications are available with information on buying food products, food preparation, nutrition, and general health.

The organization of the extension program varies from state to state and even from county to county. In most states, an extension home economist must have at least a bachelor's degree in one area of home economics.

The extension home economist presents programs to the public for both adults and youth regarding proper nutrition and food preparation techniques. Other issues addressed include critical social issues related to the nutritional well-being of the family. Some counties offer an ***Expanded Nutrition Program (ENP)*** that offers nutrition training education to individuals. ENP programs share in-depth nutritional information with various segments of the community.

In Texas, food and nutrition specialists are based at Texas A&M University. They maintain awareness of the latest nutritional information through education and research, train county extension agents, develop educational publications, and present special programs.

The two divisions of the TAES are closely linked. The agricultural division specializes in plant and soil science, food technology, and animal science. The district agents maintain experiment stations around the state with agricultural experiment stations located within each district. With the variety of climates and interests in different segments of the state, the TAES is able to conduct a variety of experiments enabling them to benefit not only Texas but many other states as well.

UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES

The ***United States Department of Health and Human Services (USDHHS)*** is a large federally funded division of the government. Many federal and state organizations are under the umbrella of the USDHHS. These organizations include the following:

- Food and Drug Administration
- state departments of health
- state departments of human services

Food and Drug Administration

The ***Food and Drug Administration (FDA)*** is an agency of the USDHHS established in 1906. The main functions of the FDA are to regulate and enforce standards of safety for the food, drug, and cosmetic industry. They also are responsible for protecting consumers against fraud in regard to food labeling. The FDA warns consumers of fraudulent labeling and publishes warnings to the public if hazardous food products are found.

Texas Department of Health

The ***Texas Department of Health (TDH)*** is involved in a variety of social programs that are usually provided through community, local, or regional operations. It is under the umbrella of the USDHHS, but it is a state-run organization. Certain guidelines are established and followed for programs receiving federal funding, but other programs are under the jurisdiction of and funded by the individual state. The fees for the services offered by the TDH are small or none. No one is refused service due to an inability to pay.

Agencies under the Texas Department of Health include the Food and Drug, Milk and Dairy, and Cooperative Meat Inspection

Agencies. These agencies inspect and regulate food processing establishments.

Some of the programs offered by the TDH include the following:
- public health clinics
- food supplements for women, children, and infants
- general education clinics
- services for children who are chronically ill and disabled
- medical care transportation
- providing baby formula and food through the Women, Infants, and Children (WIC) Supplemental Food Program

Educational materials for each of the programs or subject areas are available free. These educational materials incorporate a good deal of nutritional information.

The ***Women, Infants, and Children (WIC) Supplemental Food Program*** provides various services for the economically disadvantaged including the following:
- cards that can be exchanged in grocery stores for free, nutritious food
- health education
- referral services

In order to qualify for services provided by WIC, the following must apply:
- A woman must be pregnant or breast-feeding.
- Economically disadvantaged infants.
- Economically disadvantaged children up to age five.

Texas Department of Human Services

The ***Texas Department of Human Services (TDHS)*** is also involved in a variety of social programs related to food and nutrition. Like the TDH, this agency is under the umbrella of the USDHHS. Some programs are directed and funded federally, while others are state-operated programs. There is no fee for their services. The requirements for obtaining various benefits include proof of income and need. The TDHS provides community health information including nutritional information for the public through pamphlets, brochures, and individual training. Information on basic nutrition and nutritional recipes are included as well.

Some of the services provided by or through the TDHS include the following:
- Food Stamps
- school health services
- public health clinics
- private health care
- Head Start
- Aid to Families with Dependent Children
- medical care transportation
- school, private, and family child care services
- nutrition assistance services
- services for the aged and disabled
- Children's Protective Services
- Adult Protective Services
- Medicaid

OTHER RESOURCES

Professional Journals

Publications in professional journals as well as other periodicals provide current information on various aspects of the field of food science and nutrition. The information professional publications provide varies according to the area of food science and nutrition. Figure 24.1 includes various professional journals in the field of food science and nutrition.

Professional Publications

- *Agriculture and Food*
- *Canner Packer*
- *Chilton's Food Engineering*
- *Culinary Review*
- *Culinary Trends*
- *Executive Management's Food Processing - Marketing*
- *CRC Critical Reviews in Food Technology*
- *Critical Reviews in Food Science and Nutrition*
- *Food and Agricultural Immunology*
- *Food Engineering*
- *Food Industries*
- *Food Processing*
- *Food Research Institute Studies*
- *Food Science and Nutrition*
- *Food Technology*
- *International Journal of Food Science and Technology*
- *Journal of Agricultural and Food Chemistry*
- *Journal of the American Dietetic Association*
- *Journal of Food Science*
- *Journal of Food Technology*
- *Journal of Nutrition*
- *Journal of Nutrition Education*
- *Nutrition Today*
- *Plant and Business Food Management*
- *Prepared Foods*
- *Processed Prepared Foods*
- *Restaurant Management*

Figure 24.1

Newsletters

A variety of newsletters dispense reliable information related to food science and nutrition. They are published by organizations, medical facilities, consumer agencies, and large corporations that have food science and nutrition related products. Some of the food and nutrition newsletters that are available include the following:

- *Consumer Reports Health Letter*
- *Dairy Council Digest*
- *Food Insights* by the International Food Information Council
- *Food and Nutrition News* by the National Live Stock and Meat Board
- *Harvard Health Letter* published by the Harvard Medical School
- *Lifetime Health Letter* published by the University of Texas Health Science Center at Houston
- *Mayo Clinic Health Letter*
- *Nutrition and Health News* by the University of Texas Southwestern Medical Center at Dallas
- *Nutritional News and Views* published by Mead-Johnson
- *Tufts University Diet and Nutrition Newsletter*

Organizations

Many other organizations outside of the USDHHS distribute reliable nutritional information at the national and local levels. Some of these organizations include the following:

- ***American Cancer Society*** – This organization provides community health education, medical supplies and equipment, and educational materials for the general public and special groups.
- ***American Diabetes Association*** – This association provides community health education, information on diabetes, a speaker's bureau, and literature.
- ***American Heart Association*** – This organization provides community health education, supports cardiovascular research, offers cardiopulmonary resuscitation instructor classes, and provides educational materials and programs for the general public, schools, and professional groups.
- ***American Red Cross*** – This organization provides community health education, and disaster preparedness and relief including food and clothing, and emergency assistance service to military families on active duty.

- ***city health departments*** – These offices provide communicable disease control, community family clinics, community health education, environmental health, laboratory services, public health nursing, and vital statistics.
- ***county general assistance*** – These offices provide temporary assistance with current rent and utilities; food assistance for those not receiving food stamps, and burial of indigents (poor, needy, or destitute individuals).
- ***Easter Seal Society*** – This organization provides community health education, information research for appropriate resources, financial assistance, summer camps, and literature.

Media Distribution

The media is a valuable source of information. However, not all information conveyed through the media, especially that related to advertisements for various products, is completely accurate or reliable. This makes it difficult at times to distinguish between the reliable and the unreliable. Newspapers, magazines, and television health segments are usually accurate. Media distribution of information related to certain diseases has been very reliable and educational. The media is mainly responsible for the public's awareness of certain health issues related to heart disease, high cholesterol, and cooking oils.

Computer software programs have been developed that will evaluate and make suggestions on nutrition and diet. Programs can be used to select food with specific amounts of nutrients and to plan meals. Some programs can also analyze the nutrient value of a person's meals, snacks, and recipes. Physical activity also may be analyzed.

Numerous businesses and agencies have incorporated toll-free 800 numbers into their marketing plans. The 800 numbers allow consumers to call with questions related to a particular product. The USDA has a meat and poultry hot line available during certain hours of the day. Many poultry companies offer assistance to consumers through 800 numbers during certain holiday seasons. They may provide defrosting and cooking instruction as well as nutritional information.

When dealing with media distribution of information related to food science and nutrition, a person should be cautious. Many people believe that all information seen or transferred through the media is accurate. Unfortunately, this is not always true. A person should consider the source, read the fine print, and confirm the information through one or more of the numerous reliable sources available.

Summary

- A variety of resources are available to provide reliable nutritional information.
- The Food and Consumer Services branch of the United States Department of Agriculture consists of the Food and Nutrition Service, the Human Nutrition Information Service, and the Office of Consumer Advisor.
- The Texas Agricultural Extension Service is divided into two sections: agriculture and home economics.
- The Food and Drug Administration is a branch of the United States Department of Health and Human Services.
- A wide variety of consumer information on food science and nutrition can be obtained from professional journals, community organizations, professionals, media distribution, and educational programs.
- The Food and Drug Administration warns consumers of fraudulent labeling and publishes warnings to the public if hazardous food products are found.
- The Texas Department of Human Services provides community health information including nutritional information for the public through pamphlets, brochures, and individual training.

Vocabulary

American Cancer Society
American Diabetes Association
American Heart Association
American Red Cross
city health departments
county general assistance
Easter Seal Society
Expanded Nutrition Program (ENP)
Food and Drug Administration (FDA)
resource
Texas Agricultural Extension Service (TAES)
Texas Department of Health (TDH)
Texas Department of Human Services (TDHS)
United States Department of Health and Human Services (USDHHS)
Women, Infant, and Children (WIC) Supplemental Food Program

Review

1. Summarize the major areas of the United States Department of Agriculture.
2. How can the USDA be beneficial in locating reliable nutritional information?
3. What are the two divisions of the Texas Agricultural Extension Service and what are their functions?
4. What services are provided by the Food and Drug Administration?
5. What are the programs offered by the Texas Department of Health?
6. How can an individual benefit from the Women, Infants, and Children (WIC) Supplemental Food Program?
7. Identify ten of the social programs related to food and nutrition that are available to qualified individuals through the Texas Department of Human Services.
8. Identify five professional journals that a person could read to find reliable information related to nutrition.
9. What benefits do city health departments provide?
10. How does the media help disseminate reliable nutritional information to the public? What are some of the disadvantages of information relayed through the media?
11. What are the services offered by the Expanded Nutrition Program?
12. What organization provides inspections of food processing establishments?

Critical Thinking

Research two organizations that provide nutrition information to the public. Resources for locating nutrition education organizations include the school and public libraries, the health department, or the county extension office. Identify and summarize programs, and collect pamphlets or other publications provided by the organizations. What needs led to the formation of the organization? What is the organization's primary purpose or target audience? Organize the data you collected in categories including information provided to the public, target audiences, services provided, accessibility, etc. How can you or a family member benefit from the nutrition information provided by this organization? Speculate about the future of these organizations. What might the needs be in twenty-five years? fifty years? one hundred years? Share your findings and conclusions with the class.

25

Careers in Nutrition and Food Science

ESSENTIAL ELEMENT

- ☐ Relate personal characteristics to the appropriate career(s) addressed within each home economics course.(a7A)
- ☐ Identify employment opportunities and preparation requirements in chosen field.(a2A)
- ☐ Describe management practices facilitating individuals assuming multiple roles. (a7B)
- ☐ Discuss demands and rewards in relation to personal and family life. (a7C)
- ☐ Demonstrate effective money management.(a7D)

OBJECTIVES

- ☐ Evaluate career opportunities in advanced food science and nutrition.
- ☐ Analyze the effects inadequate interpersonal qualities have on job success.
- ☐ Compare the advantages and disadvantages of entrepreneurship.
- ☐ Assess the importance of management practices when dealing with multiple roles.
- ☐ Illustrate the need for effective money management.

CAREERS IN FOOD SCIENCE AND NUTRITION

A career in food science and nutrition offers a variety of challenges. Food technology is part of the world's largest industry. Opportunities include, but are not limited to, the following:

- improving consumer food products
- identifying new food sources
- discovering new preservation methods
- developing foods for space travel
- evaluating food
- identifying methods and procedures for food distribution
- developing and testing food additives
- determining standards of safety for foods
- developing convenience foods
- providing food product and service quality control
- conducting food processing research
- designing product packaging
- educating the public about food science and nutrition

Employment Opportunities

Creativity and career goals influence the type of career a person selects in the field of food science and nutrition. Potential careers include a variety of occupations including quality control manager, hospital dietitian, or food researcher. There also are opportunities in education, industry, and government. A person can work independently, as a member or leader of a research team, or as the leader of a processing facility.

In industry, a person could work in the various areas of food processing, packaging, and marketing or in product development and sales. In education, a person could teach at the high school, college, or university level or be involved in fundamental research related to nutrition, microbiology, and food toxicology. Government opportunities include government agencies dealing with food supplies, processing, food safety, and inspection. Government agencies involved include the following:

- Commerce Department
- Defense Department
- Department of Agriculture
- Department of Health and Human Services

Careers in food science and nutrition offer opportunities to travel and live in a variety of locations around the world. International organizations offering opportunities in food science and nutrition include the World Health Organization of the United Nations and the Food and Agriculture Organization. Other opportunities and needs include food scientists, nutritionists, and home economists with expertise in nutrition and foods to work in developing countries through the Peace Corps, U.S. AID, and other similar organizations.

Basic training and practical work experience will help increase an individual's work choices. Further education and professional training will help a person progress to another job level or occupation in management or administration. Both can also increase an individual's potential income.

Figure 25.1 represents various occupational opportunities available in the field of food science and nutrition.

Professional Home Economics Occupations

The term ***home economist*** is a general term used to describe a person with at least a bachelor's degree (from a four-year university) in one area of home economics.

A certified home economist (CHE) is a home economist who has successfully passed the national examination to become certified as a home economist. In addition to the professional-level jobs previously identified, there are a variety of home economics occupations that require knowledge and training related to food science and nutrition. A home economics teacher is a professional with at least a bachelor's degree in vocational home economics education. Many home economics instructors teach classes in different subject

Opportunities in Food Science and Nutrition

Dietetics

- Registered Dietitian
- Therapeutic Dietitian
- Clinical Dietitian
- Educational Dietitian
- Administrative Dietitian
- Consulting Dietitian
- Food Service Director
- Food Service Manager
- Cafeteria Supervisor
- Restaurant Manager
- Dietitian in Community Nutrition
- Research Dietitian
- Dietitian in Sports Medicine

Entry-level occupational opportunities may involve assisting professionals in the area of dietetics.

Food Science

- Food Scientist/Technologist
- Research Scientist
- Quality Control Manager
- Plant Manager
- Research and Development Supervision
- Production Manager
- Food Ingredient Sales
- Food Chemist
- Food Laboratory Manager
- Process Engineer
- Equipment Designer
- Consultant

Entry-level occupational opportunities may involve assisting professionals in the area of food science.

Human Nutrition

- Nutrition Research Specialist
- Nutrition Consultant
- Public Health Nutritionist
- Food Chemist
- Biochemist
- Food Scientist

Entry-level occupational opportunities may involve assisting professionals in the area of human nutrition.

Food Preparation Professional

- Assistant Restaurant Manager
- Restaurant Manager
- Chain Executive
- Personnel Director
- Training Director
- Menu-Maker
- Merchandising Supervisor
- Advertising Director
- Recipe Development Director
- Business Manager
- Business Owner

Skilled Workers

- Food Assembler
- Chef
- Cook
- Baker
- Kitchen Supervisor
- Meat Cutter
- Purchasing Agent
- Caterer's Helper

Entry-level Positions

- Kitchen Helper
- Assistant Cook
- Assistant Baker
- Busperson
- Server
- Dishwasher

Figure 25.1

areas of home economics including food science and nutrition. Thus, a basic knowledge of food science and nutrition is necessary for any home economics teacher. Home economics professionals who teach at colleges and universities are usually required to have a master's degree and a doctor's degree. In some cases, these teachers specialize in teaching one area of home economics such as nutrition. These professionals also are usually required to conduct research in areas of interest related to their teaching fields and also may be required to be dietitians.

Home economists hired by the Cooperative Extension Service teach foods and nutrition in addition to other home economics subjects. These home economics professionals provide instruction in formal settings such as classrooms and in informal settings such as community buildings and homes. They also present radio and television programs, work with organized groups of youth and adults and develop educational materials. Extension professionals must be well-organized and able to work well with people. They also should have thorough knowledge of home economics. In most states, an extension home economist must have at least a bachelor's degree in one area of home economics.

Some companies hire home economists as consultants. For example, a utility company might hire a home economist for a temporary time period to teach classes on cooking and using different types of energy including gas, electricity, microwave, or convection. Such temporary assignments are often called freelance work. ***Freelance work*** is done by professionals who are not employed on a regular basis but who are hired to complete specific assignments.

Some companies hire home economists as consultants in full-time, permanent positions. Different companies attach different titles to these jobs. For example, a consultant for a food manufacturer might be called a consumer relations representative. This professional might answer customers' questions about the company's products and services, provide information to customers on food preparation methods, and develop educational materials to promote the company's products and services. A food service wholesaler might hire a home economist as an educational representative to develop and present training programs for retailers who sell the company's products. Home economists with training in advertising or communications may be hired by broadcast media firms, newspapers, advertising firms, and other communications-related employers to handle food-related accounts.

There are a variety of organizations, associations, and institutes related to the food science and nutrition field that provide employment opportunities to home economists. In most cases, these home economists represent the organizations and must have poise and the ability to make presentations to groups. Research laboratories in colleges, universities, manufacturing plants, and research centers sometimes hire home economics professionals to conduct research related to food science and nutrition. Research home economists must enjoy working in laboratory settings, have good analysis skills, and be willing to attend to details.

Preparation Requirements

Food Scientist. An individual wanting to become a food scientist should have a minimum of a bachelor's degree from a college or university offering studies in food science and nutrition. Courses of study will include chemistry, biochemistry, microbiology, and physics as well as courses in food technology including processing, preservation, sanitation, storage, and marketing of foods and food products. The Institute of Food Technologists outlines a general course work schedule for a food scientist in the following percentages:

• Food Science	25 percent
• Chemistry	10 percent
• Humanities	10 percent
• Physics	5 percent
• Math and Statistics	10 percent
• Bio-Science and Nutrition	10 percent
• Communications	10 percent
• Electives	20 percent

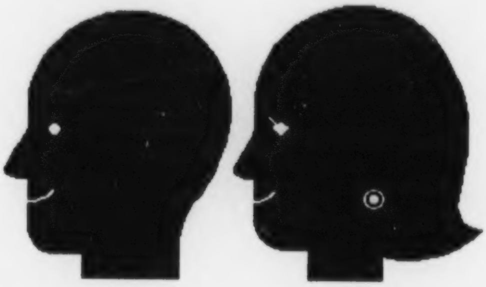
Courses in business, administration, and economics are beneficial if a career in management or administration is desired.

Food Science Technician. Food science technicians can receive their education and training at various technician training schools, community vocational schools, and many junior colleges. Most programs for food science technicians are scheduled to be completed in two years.

Dietition. A person interested in becoming a registered dietitian must have a minimum of a bachelor's degree from an accredited college or university. An accredited college or university must offer a program approved or accredited by the American Dietetic Association. In addition to the course program, a person also must complete a supervised practice as well as pass a national examination to become a certified registered dietitian. The supervised practice can be completed by enrolling in a program that incorporates the academic courses with the supervised practice or by completing the academic requirements followed by an accredited Dietetic Internship of an Approved Preprofessional Practice Program.

Dietetic Technician. To become certified as a registered dietetic technician, a person must have completed an approved two-year program (usually offered at a junior college) and passed the national examination.

The cost of any trade school, college, or university can be expensive. Fortunately, many scholarships, grants, and other types of financial aid are available to graduating high school seniors and college students. Financial aid is available to students based on need, scholastic achievement, and an interest in a particular field. Information regarding financial aid is available from individual schools, colleges, and universities.



PERSONAL CHARACTERISTICS

Finding a job that offers personal satisfaction, adequate wages, and opportunities to learn and advance is a major accomplishment. It takes time and effort not only to look for a job but also to keep a job. In order to become successful employees, individuals must possess qualities desired by employers as well.

There are many characteristics or qualities that employees need in any job in order to be successful. Employers look for these personal traits when people apply for jobs. Employers also consider these qualities when evaluating employees after they are hired. A person's failure to keep a job is often due to a lack of desirable personal qualities rather than a lack of job skills. Personal qualities can be developed and improved if a person makes a sincere effort. Honest self-evaluation can help a person determine strengths and weaknesses. Honest self-criticism often leads to employment success. Each work experience helps an individual strengthen his or her interpersonal qualities and prepares him or her for future employment and a productive personal life.

Positive Attitude

A ***positive attitude*** is a way of acting, feeling, or thinking in which an individual shows a favorable mood or outlook. Therefore, a positive work attitude involves thinking about work in a favorable manner. It is easier for a person to secure and keep a job if he or she has a positive attitude. An employee expresses a positive attitude by showing enthusiasm and willingness to learn. Enthusiastic employees are more productive than employees lacking enthusiasm for work. They concentrate on the positive attributes of a job as well as the positive attributes of other people.

It is also important for an employee to develop an attitude of loyalty to his or her employer. A loyal employee follows the rules and policies of a business, and she or he is concerned with the quality of work and services provided.

Employees should avoid gossiping about other employees and supervisors since negative comments about other people tend to cause individuals to develop negative impressions of the persons discussed. When a person develops a negative attitude, it is often difficult for him or her to be open-minded and fair toward other people.

Having a positive attitude toward co-workers helps to maintain a pleasant work environment. The ability to get along with others influences success in any job. A friendly, sincere manner, willingness to do one's share of the work, and respect for the knowledge and skills of other employees helps provide good relationships. Positive attitudes toward the employer, other employees, and the job help a person to deliver high-quality performance. In addition, a positive attitude can lead to promotions. A highly skilled employee who is negative and uncooperative may not be as valuable to a company as an average skilled employee who is positive, enthusiastic, and eager to learn. There is no substitute for hard work in obtaining job success.

Self-control

Self-control is the ability of an individual to restrict her or his own emotions and actions. There are times in any job situation when problems occur and it may be difficult to remain calm. However, a successful employee must keep his or her temper under control and avoid unpleasant confrontations with co-workers, supervisors, and other individuals. An individual can develop self-control by maintaining a pleasant disposition. Pausing to think before speaking or taking rash actions also helps a person to control himself or herself. Learning to remain calm in difficult situations is an important trait for any employee. Working hard to perform well and obtain the respect of supervisors and co-workers makes self-control easier. A person should learn to accept constructive criticism and remain friendly. These practices help a person develop a pleasant temperament.

Initiative

Initiative is the ability to think and act without being prompted. An employee with initiative is willing and has the ability to observe tasks that need to be done and complete them without being told to do so. A willingness to learn is also a sign of initiative. The employee who is eager to learn will ask about opportunities for growth and learning. Employers recognize initiative by giving increasing responsibility to those employees who show an interest in opportunities to learn new skills.

Cooperation

Cooperation involves willingness to listen to other people's views and opinions and to work toward common goals. Employees should become familiar with and follow the rules and policies of their employers. Willingness to complete all assigned tasks with a positive attitude is another characteristic of a cooperative employee. Even if personality problems exist between two employees, it is important for both individuals to avoid petty differences and work together as well as possible. Willingness to cooperate with co-workers and supervisors without insisting on doing things a particular way contributes to a positive work environment for everyone.

Honesty

Honesty means being trustworthy, fair, and sincere. Employers expect employees to show honesty by maintaining high ethical standards, telling the truth, and handling the employer's possessions with care. Dishonest behavior includes stealing from a company and using company property for personal use. The most common item employees steal from employers is time. Employees who report to work late, take extra time at breaks and lunch, leave work early, make personal phone calls, remain idle, and visit with other employees are using time for personal use that should be spent working. An employee should show honesty by providing the employer with a full day's work in exchange for wages. Dishonest behavior is a common reason employees are dismissed.

Accuracy

Accuracy is the condition of being thorough, exact, and free of mistakes. An employer expects employees to perform work accurately since accuracy is following procedures correctly without supervisors having to repeat instructions. The ability to follow instructions exactly as the procedure manual outlines or as the supervisor directs is important to a company's productivity. In addition, employees are often evaluated on their ability to follow instructions and perform tasks accurately. Paying attention to details rather than being careless in one's work habits helps develop accuracy.

Communication

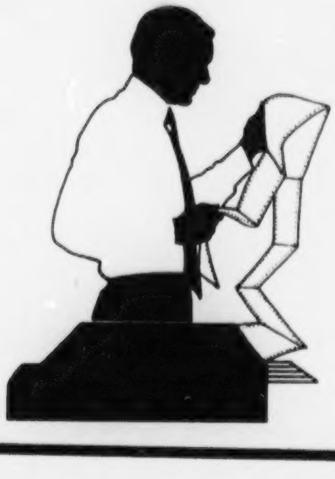
Communication is the giving and exchanging of information. Information such as ideas, data, and instructions is exchanged in the workplace daily. Therefore, the ability to communicate effectively with other people is important in succeeding on the job. Skills necessary for effective communication include listening, speaking, reading, and writing. It is also important to learn to pronounce words correctly, use correct grammar, and become familiar with terms used in a particular job setting. Employees must be able to use these skills to send and receive messages that can be understood clearly.

Personal Appearance

Personal appearance or the way a person looks is an important factor in achieving job success. An individual's appearance affects the way others react to him or her and influences how an individual feels about himself or herself. People enjoy being around neat, well-groomed individuals. Individuals with messy appearances are often perceived as being insensitive and uncaring. Appearance also is important since it is often the first impression people have of an individual.

All employees benefit from having a good appearance, but it is especially important for employees who come in contact with the public to have a fashionable and neat appearance. To develop a positive and pleasing appearance, a person should use the following guidelines:

- Check clothing and general appearance before going to work.
- Make needed repairs to clothing on a regular basis.
- Stay aware of fashion trends and choose clothing that is fashionable.
- Choose sensible clothing that is appropriate for the employment situation.
- Select clothing that fits properly.
- Have hair cut or trimmed on a regular basis in an appropriate style.
- Wash hair as needed to maintain cleanliness, and style hair daily.
- Apply moderate amounts of makeup to a clean face, if female.
- Shave and/or neatly trim beard or mustache, if male.
- Make regular visits to the dentist.
- Maintain fresh breath and clean teeth by brushing, flossing, and practicing dental hygiene.
- Keep hands cleaned and nails well manicured.
- Take a bath or shower daily and use a reliable deodorant.
- Select sensible shoes that are clean and in good condition.
- Maintain proper posture when sitting, standing, and walking.
- Make a habit of smiling.



Professionalism

Professionalism is competent behavior that is of a high standard or status. Professional behavior is exhibited when an employee's performance is above the standards set for tasks, when the employee is loyal and respectful to superiors, and when the employee is considerate of co-workers. Professional dress also is important in creating a professional image. An employee is more likely to gain the respect and attention of co-workers, supervisors, and others when she or he is well-groomed and wears clean clothing appropriate for the job.

Professionalism involves not only professional behavior but also professional growth. Membership and active participation in professional organizations are indications that an employee is interested in the profession and in personal and professional improvement. Publications from professional organizations provide current information on various aspects of a field. The information professional publications provide varies according to the field in which one is employed.

Professional growth also can be obtained by participating in continuing education programs offered in the workplace or by local educational institutions. Many professional organizations offer certification courses in which employees are trained according to specified requirements set forth by the organization. Employees should strive to achieve professionalism since it often prepares them for advancement into positions requiring higher levels of skill.

ENTREPRENEURSHIP

An ***entrepreneur*** is a person who owns and operates his or her own business. An entrepreneur usually sells a new product or service. Entrepreneurs are usually hard workers who believe in the free enterprise system. ***Free enterprise*** is the freedom of individuals to organize and operate businesses for profit in a competitive system without governmental interference. Free enterprise is a characteristic of capitalism and the economic system of the United States. Under capitalism, most production means are owned by private citizens. In a free enterprise system, entrepreneurs can earn profits by taking the risk of investing ***capital*** or cash in goods used to produce goods or provide services. Capital is usually used to buy items such as furniture, equipment, machinery, buildings, fixtures, operating cash, and supplies. The ultimate goal of an entrepreneur is to make a profit. The entrepreneur risks both failing and losing his or her initial investment.

Most businesses in the United States are organized as sole proprietorships, partnerships, or corporations. The ***sole proprietorship*** is a business owned by one person. A ***general partnership*** is a legal business relationship in which two or more individuals share responsibilities, resources, and profits equally. A ***limited partnership*** is a legal business relationship in which, according to a written agreement, some owners have a limited liability for business debts and are not involved in the day to day operations of the business. These individuals are sometimes known as ***silent partners.*** A ***corporation*** is a legal business relationship in which a group of persons join to create an entity treated by law as a separate individual. Through its officers, the corporation makes contracts, conducts business activities, and assumes responsibility for debts.

One primary goal of businesses is to satisfy consumer demand for goods and services. Business functions include production of raw materials, manufacturing, wholesale operations, and retail sale. Small businesses are involved in all functions of business, but they primarily provide products and services to consumers through retail sale. At the retail level, many small businesses are franchises. A ***franchise*** is a right or license granted to an individual or group to market a company's goods or services. A ***franchiser*** grants a franchise and offers a proven market strategy for a product, service, or method. A ***franchisee*** is a person or group to whom a franchise is granted. Usually, a franchisee invests capital in exchange for the expertise and widely known product image of the franchiser. Often, the fee includes the cost of inventory with which the franchisee begins business. Many fast-food operations are operated as franchises.

In some cases, entrepreneurs develop an idea for a product or service related to food and nutrition and decide to create a business. It is important for the product or service to be one that is wanted or needed by enough people that the business can survive and eventually make a profit. Some entrepreneurs start their businesses at home and expand later as the businesses grow. Catering businesses often begin in this manner.

Successful entrepreneurs are usually characterized by the following traits:

- individualism and initiative
- willingness to take a risk
- desire for self-expression
- persistence
- creativity and inventiveness
- technical knowledge of how to operate a business

- ability to survive financially if emergencies occur
- patience to wait until the business becomes successful
- ambition, energy, and drive
- ability to make decisions
- ability to take full responsibility for decisions
- realistic expectations about the amount and types of work required
- ability to communicate
- resources to survive with lack of income

MANAGEMENT PRACTICES AND MULTIPLE ROLES

Today, individuals have different careers, lifestyles, and family roles. In order to manage all of these roles, an individual must possess management skills.

Managing Multiple Roles

Management is the act of supervising people or activities to obtain results. Management is an effective tool for creating change and reaching desired outcomes. Management requires the use of resources to meet personal and family goals. A resource is a source of supply or support. Resources include skills, energy, time, knowledge, money, natural surroundings, social organizations, community facilities, and political institutions.

A ***goal*** is an object or end that a person or family strives to obtain. Goal setting refers to the identification of what a person or family wants to achieve. Setting goals is the first step in improving a person's effectiveness and being successful in life and work. Goals are influenced by values, standards, needs, wants, and priorities.

Values are the worth attached to ideas or objects. In management, values are the underlying force that directs action. Values are usually personal feelings such as the belief in freedom, honesty, and hard work. Values can be held on a personal and family level. Family values may be passed down from generation to generation.

Standards serve as criteria used to evaluate behavior, objects, and feelings. Standards are the characteristics that a family or individual accepts as adequate. Standards often serve as the criteria for reaching goals. For example, one person may feel that a high standard of education is attaining a high school diploma while another may perceive a high standard of education as obtaining a bachelor's or graduate degree from a university.

A ***need*** is a condition in which something is required for the physical or mental well-being of an individual. A ***want*** is a condition in which something desirable is lacking. A want differs from a need in that a want is not necessary for survival. Human needs and wants often provide the motivation necessary for survival. Human needs and wants often provide the motivation necessary to begin the management process. For example, shoes are a need, but a pair of designer shoes that cost $150 is a want.

Priorities are activities or actions that demand attention over other activities or actions. Priorities should be established when setting goals. Individuals must consider what must be done, what should be done, what individuals want to do, and what individuals do not want to do.

The amount of time required to obtain a goal also should be considered. Short-term goals are goals that may be reached in a short period of time. This time period is usually less than one year. Examples include passing an English exam or buying a new dress. Long-term goals may take several years to reach. When prioritizing goals, it is important to make all goals realistic. Individuals and families must have the resources to obtain their goals. Figure 25.2 represents the intricate process of establishing and accomplishing goals.

Setting goals involves working toward a purposeful change and reaching desired outcomes either through personal management or family management. Therefore, proper management is an effective way for an individual or family to reach goals.

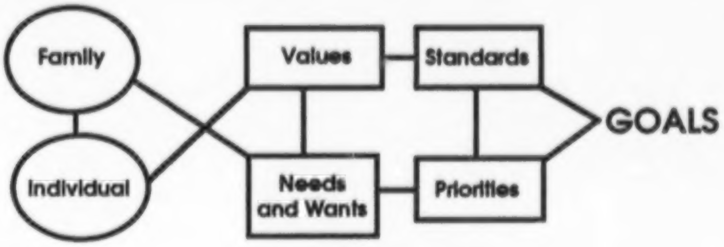


Figure 25.2

Stress

Most individuals and families experience pressures and hardships at some point in their lives. The condition in which one experiences a high level of demand that causes tension is referred to as ***stress***. People react differently to stress. Stress can be positive or negative depending upon how an individual copes with it. Stress can be positive when it motivates an individual to accomplish tasks she or he might not otherwise complete. When stress becomes prolonged or particularly frustrating, it can become harmful. Too much stress is referred to as ***distress***. Distress is negative and can be both physically and emotionally harmful.

Stress has been associated with the high rate of coronary disease in the United States today. Coronary disease is often the result of stress-producing, high-pressure jobs. Medical research has shown that the origins of many common diseases are related to stress. Some of the common diseases include high blood pressure, ulcers, backaches, insomnia, and headaches. Stress also has been recognized as a contributing factor to cancer. Some mental health research has shown that stress frequently underlies both emotional and behavioral problems including nervous breakdowns.

Stress comes from mental or emotional activity as well as from physical activity. It can be influenced by a person's job or personal life. Stress is unique to each individual. It is so personal that what may be relaxing to one individual may be stressful to another. A person who enjoys staying busy and active at all times may find it very stressful to spend a day on the beach doing nothing at all. That situation may make a person feel very frustrated and nonproductive. It may be very upsetting and cause distress. On the other hand, people who prefer working at their own pace and setting their own hours may feel very stressed or distressed in a situation where they must meet deadlines and punch a time clock.

It is impossible to live a life completely free of stress. Recognizing the early signs of distress or too much stress and then doing something about it can make an important difference in the quality of an individual's life. It may actually influence an individual's survival.

The important issue when managing stress is recognizing what causes stress and then determining methods of reducing the stress. It is important to select a job or career that is beneficial to the individual and provides positive stress instead of negative stress.

EFFECTIVE MONEY MANAGEMENT

Money is the main reason people work outside of the home. Income must be well managed or the goals for which the job was taken may never be achieved.

Salaries

Salaries refer to payment for work done. Employees are paid using different salary or compensation plans. Each business has policies regarding how employees are paid for the work they do. In most cases, a business will use different payment plans for different types of employees. For example, employees whose primary responsibility is for freelance work may be paid after each job they complete or by the hour. If an employee works full time, he or she is more likely to be paid on a straight salary compensation plan. Paychecks may be received weekly, bimonthly, or monthly.

A minimum wage was first established in 1938. The original federal law called for a minimum wage of twenty-five cents per hour. Since 1938, the minimum wage has increased steadily and is projected to continue to increase. ***Minimum wage*** is the lowest amount of money an employee can be paid per hour. It is set by law. Most entry-level employees are hired at minimum wage. As experience is gained, hourly salaries may increase to amounts above the minimum wage rate.

Employee Incentives

An ***incentive*** is a reward that acts as a motivation for an employee to be as productive as possible. Incentives are not offered to employees in all businesses. Incentives tend to tie performance to personal initiative. The following types of rewards are sometimes used as incentives to compensate employees:

- medical insurance
- pension or retirement plans
- sick leave
- vacation time in addition to regular annual leave
- bonuses in cash, services, or goods

Some incentives may be in the form of cash while others may receive incentives that are not. ***Fringe benefits*** refer to forms of payment or incentives other than money. Company cars, medical insurance, sick leave, vacation time, and holidays are examples of fringe benefits. Incentives and fringe benefits can help in budget expenses and planning for the future. These two items can help free income that would otherwise be spent on insurance or recovering from a loss of income when unable to work due to illness. Locating an appropriate job, getting paid an adequate salary, and receiving fringe benefits are all important considerations when selecting a job.

Budgets

A ***budget*** is a plan for spending and saving income. There are five basic steps to developing a satisfactory budget.

1. Determine needs and wants.
2. Examine fixed expenditures and income.
3. Develop a financial plan or budget.
4. Implement the plan.
5. Evaluate the plan.

Needs and wants were discussed earlier in the chapter. Fixed expenditures and income can be examined by reviewing past expenditures. This enables an individual to estimate how much money is needed to meet the household's needs. Household expenditures differ from one family to another. Extra costs should be considered before a person accepts a job offer to ensure that the benefits of the job will outweigh the extra expenses. Examples of extra expenses

SAMPLE BUDGET	
Percent of Income	**Expenses**
15 - 20 percent	Debt Payments (including car, loan, and credit card payments)
25 - 35 percent	Housing (including mortgage or rent, taxes,insurance, and utilities)
15 - 20 percent	Food (includes eating out)
10 percent	Clothing
5 - 10 percent	Transportation (includes gas, insurance, and repair)
10 percent	Savings
10 - 20 percent	Miscellaneous (includes entertainment, medical insurance and expenses, education costs, personal grooming supplies, recreation, and charitable contributions)

Table 25.1

might include professional clothing, child care, transportation, additional income tax, and additional funds needed for time spent between jobs without income.

When developing a financial plan or budget, a person must consider the items mentioned earlier. It is also important to remember a miscellaneous fund for unexpected bills or bills that exceed the budgeted amount. An emergency fund also is important to cover expenses in case the wage earner is ill or there is a layoff which results in a lack of income. The equivalent of two to six months income is suggested for an emergency fund.

Savings is another important factor when developing a financial plan or budget. A guideline for the amount to place in some type of savings plan is ten percent of income.

Table 25.1 is an example of a sample budget. It is important to remember that the percentages are only suggested limits. These percentages may vary depending on the situation. No two individuals' or families' incomes or needs are exactly the same.

Once a plan has been decided upon and implemented, it is important to evaluate the plan on a regular basis. Adjustments should be made if necessary. The evaluation can be done monthly or every two or three months. Evaluating the plan properly and making needed adjustments helps eliminate financial difficulties. Financial difficulties can cause problems in the workplace and at home.

Summary

- ❑ Potential careers in food science and nutrition include a variety of occupations with opportunities in education, industry, and government.
- ❑ A home economist is a person with at least a bachelor's degree in one area of home economics.
- ❑ An individual wanting to become a food scientist should have a minimum of a bachelor's degree from a college or university offering studies in food science and nutrition.
- ❑ A positive attitude is a way of acting, feeling, or thinking in which an individual shows a favorable mood or outlook.
- ❑ Cooperation involves willingness to listen to other people's views and opinions and to work toward common goals.
- ❑ Professional behavior is exhibited when an employee's performance is above the standards set for tasks, when the employee is loyal and respectful to superiors, and when the employee is considerate of co-workers.
- ❑ An entrepreneur is a person who owns and operates his or her own business.
- ❑ In order for individuals to manage different careers, lifestyles, and family roles, an individual must possess management skills.
- ❑ The condition in which a person experiences a high level of demand that causes tension is referred to as stress.

Vocabulary

accuracy
budget
capital
communication
cooperation
corporation
distress
entrepreneur
franchise
franchisee
franchiser
free enterprise
incentive
initiative
limited partnership
management
minimum wage
need
personal appearance
positive attitude
priorities
professionalism
salaries
self-control

freelance work
fringe benefits
general partnership
goal
home economist
honesty
silent partners
sole proprietorship
standards
stress
values
want

Review

1. What are five occupational opportunities available in the field of food science and nutrition?
2. What opportunities are available for a home economist in the field of food science and nutrition?
3. What preparation requirements are needed for an individual to become a food scientist?
4. How does a positive attitude affect a person's job success?
5. Why is initiative a positive quality in a job situation?
6. How does personal appearance affect job success?
7. What is professionalism?
8. How does a person manage multiple roles?
9. How can effective money management be achieved?
10. What are some advantages and disadvantages of entrepreneurship?
11. How does communication affect job performance?
12. Why is honesty an important factor in achieving job success?

Critical Thinking

Select an occupation in the field of advanced food science and nutrition. Through the classified ads, journal classified advertisements, or personal interview, locate a specific job and research it. Determine the preparation requirements, number of hours per week involved, salary, geographic location, qualifications, office attire, possibility of advancement, and other aspects of the job. Share your findings with the class. How does the job you investigated compare with jobs your classmates researched? Considering your own personal interests and talents, which job would be the best for you? Give reasons to justify your response. Think about the field of food science and nutrition and the information you have learned from this text. What will the jobs of dietitians, food scientists, food technologists, nutritionists, and others in the industry be like in the twenty-first century?

Establish a budget on the job researched above. Use the percentages from the sample budget provided. Use the classified ads or other sources to determine housing costs. Similar research should be done for other expenses including food, clothing, transportation, and miscellaneous expenses. Compare the salary and the proposed budget. Does the salary provide enough money for all projected expenses including both wants and needs? If married, would two incomes be necessary to cover the expenses? In what ways could expenses be cut?

REFERENCES

Boyle, M.A. and Whitney, E.N. *Personal Nutrition*. St. Paul, Minnesota: West Publishing Company, 1989.

Bryant, C.A., Courtney, A., Markesbery, B. A., and DeWalt, K.M. *The Cultural Feast, An Introduction to Food and Society*. St. Paul, Minnesota: West Publishing Co., 1985.

Catsberg, C.M.E. and Kempen-van Dommelen, G.J.M. *Food Handbook*. England: Ellis Horwood Limited, 1990.

Clydesdale, F. *Food Science and Nutrition: Current Issues and Answers*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1979.

Chalmers, I. *Great American Food Almanac*. New York, New York: Harper & Row, 1986.

Duyff, R.L., Hasler, D. and Ohl, S.S. *Modern Meals*. Oklahoma City, Oklahoma: McGraw-Hill, Inc. School Division, 1990.

Felix, C.W. *Food Protection Technology*. Chelsea, Michigan: Lewis Publishers, Inc., 1987.

Freeland-Graves, J.H. and Peckham, G.C. *Foundations of Food Preparation*, 5th ed. New York, New York: MacMillan Publishing Company, 1987.

Handbook of Food Preparation, 8th ed. Washington, D.C.: The American Home Economics Association, 1980.

Hegarty, V. *Decisions in Nutrition*. St. Louis, Missouri: Times Mirror/Mosby College Publishing, 1988.

Hughes, C.C. *The Additives Guide*. New York, New York: John Wiley and Sons, 1987.

Jelen, P. *Introduction to Food Processing*. Reston, Virginia: Reston Publishing Company, Inc., 1985.

Krause, M.V. and Mahan, L.K. *Food, Nutrition, and Diet Therapy*, 7th ed. Philadelphia, Pennsylvania: W.B. Saunders Company, 1984.

Largen, V.L. *Guide to Good Food*. South Holland, Illinois: Goodheart-Wilcox Company, Inc., 1988.

Medved, E. *The World of Food*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1990.

Roberts, H.R. *Food Safety*. New York, New York: John Wiley and Sons, 1981.

Tannenbaum, S.R. *Nutritional and Safety Aspects of Food Processing*. New York, New York: Marcel Dekker, Inc., 1979.

Vernon, A.R. *Foods*. Changing Times Education Service. St. Paul, Minnesota: EMC Publishing, 1988.

Wardlaw, G.M. and Insel, P.M. *Perspectives in Nutrition*. St. Louis, Missouri: Times Mirror/Mosby College Publishing, 1990.

Whitney, E.N., Hamilton, E.M.N. and Boyle, M. *Understanding Nutrition*, 4th ed. St. Paul, Minnesota: West Publishing Company, 1987.

INDEX

A

- **accuracy 305**
  - defined 305
  - needed for employment 305
- **acesulfame-K 83**
- **acetic acid 51**
- **acids 41**
  - defined 41, 134
  - effects on vegetables 134
  - for food preservation 102
- **active dry yeast 194**
- **additives**
  - common 51
  - for food preservation 102–103
  - safety of 52–53
  - synthetic 52
- **adulterated foods 257**
  - defined 54
- **adulteration 93**
  - defined 122
- **advertising 275–276**
  - cost of 278
  - defined 275
  - direct marketing 276
  - industrial 276
  - local 276
  - national 276
  - professional 276
  - trade 276
- **agencies**
  - food quality and wholesomeness regulation 124–126
  - related to nutrition information 288–295
- **aging**
  - and nutrition 22–23
- **agitators 153**
- **Agricultural Cooperative Service 289**
- **Agricultural Marketing Act 123**
- **Agricultural Marketing Service 289**
  - defined 127
- **Agricultural Research Service 290**
- **Agricultural Stabilization and Conservation Service 288–289**
- **agriculture**
  - advances in research 267
  - capabilities and food supply 60
  - technological advances in 255–256
- **air**
  - leavening agent 192
- **albumen 200**
- **alkaline 41**
- **alpha tocopherol 214.** *See also* Vitamin E
- **alternative food sources 7–8**
- **altitude 181**
  - and food cookery 181
- **aluminum 162–163**
- **American Cancer Society 294**
- **American Diabetes Association 294**
- **American Food Production and Distribution 272–274**
- **American Heart Association**
  - defined 294
  - diet 20
- **American Red Cross 294**
- **amino acids 238**
- **analogues**
  - defined 239
  - meat 84–85
- **anemia 21**
- **animal**
  - and human studies 265–266
- **Animal and Plant Health Inspection Service 289**
- **anorexia nervosa 20–21**
  - defined 20–21
  - symptoms of 21
  - treatment for 21
- **anticaking agents 49**
- **antioxidants 49, 51**
  - defined 40
- **aquaculture 62, 257**
  - defined 52, 257
- **Arabidopsis Thaliana 264**
- **arcing 164**
- **artificial**
  - defined 84
  - foods 274
- **ascorbic acid 51, 214.** *See also* vitamin C 244
- **aseptic packaging**
  - defined 103–104
  - for food preservation 103
- **ash 258**
- **aspartame 83**
- **Association of Official Analytical Chemists (AOAC)**
  - defined 258, 266
- **atherosclerosis**
  - defined 16–18
  - risk factors 18

B

- **bacteria 94**
  - defined 95
  - in fermentation 106
- **baked goods**
  - cookery of 219
  - pies and pastries 221
- **baking 207, 213**
- **baking powder**
  - defined 192–193
  - types 192–194
- **baking sheets 166**
- **baking utensils 161**
- **bases**
  - defined 134
  - effects on vegetables 134
- **basic food groups 236.** *See also* food groups and food guide
- **basic utensils 164–168**
- **batter method 153**
- **batters**
  - defined 188
  - drop 188
  - pour 188
- **beating 154**
- **beef**
  - defined 203
  - tallow
    - fat composition of 227
- **bench model mixer 153**
- **Bennimix 73-75**
- **beta carotene 51**
- **BHA 51**
- **BHT 51**
- **binge eating 21**
- **biotechnology 62, 81–82**
  - defined 62

  in food science research 267
biotin 214
  defined 244
biscuit method 152
blanching 40
bleaching agent 49
blenders 153
blood cholesterol. *See also* cholesterol
  dietary goals for lowering 18
bloom 200
boiling 175, 207, 213
  defined 175
boiling point 132
bone 203
botulism 96, 143
braising 175, 205
  defined 175
bread knife 167
breads
  servings from food group 236
  unleavened 189
breakfast cereals
  carbohydrates in 242–243
brine 103
British Food and Drugs Act 121
broiler 208
broiling 175–176, 207, 213, 215
  defined 175–176
  dry-heat cooking method 205
budding 194
budget
  defined 310
  sample 311
bulimia 21–22
  characteristics of people with 21
  defined 21
  effects of 21
  treatment for 22
Bureau of Alcohol, Tobacco, and Firearms 124
butter 228
  defined 228
  fat composition of 227
  storage of 180
butterfly 206

C

cake pans 166
calciferol 214, 243
See also vitamin D
calcium
  defined 33
  foods rich in 34
  functions and sources of 246
  values in various foods 114
calcium phosphate 51
calcium propionate 51
calcium sorbate 51
cancer
  related to nutrition 16
candling 200
canned foods 140–144
  storage of 181
canning
  boiling-water bath 105
  defined 104, 140–142
  for food preservation 104–105
  steam-pressure method 105
canola oil
  fat composition of 227
capital 307
capon 208
caramelization 133
carbohydrates 215–221, 240–243
  complex 28, 241
  cookery of 215–221
  cookery of baked goods 219–221
  defined 28
  microwave cooking of 218
  simple 28, 241
carbon dioxide 187
cardiovascular disease 16
careers
  in food science and nutrition 300–303
  preparation requirements 302–303
carob bean gum 51
carrageenan 51
cast iron 162
cell fusion 256
cellulose 51, 241–242
Centers for Disease Control 124–125
cereals
  servings from food group 236
certified home economist 300–302
chalaza 200
chapati 189
cheese
  cookery 211–212
  microwave cookery of 212
  servings from food group 236
  storage of 180
  types of 211
chemical additives
  and food processing 115
  for food preservation 102–103
chemical agents
  leavening agent 192–197
chemical properties 132–135
  defined 132–133
chemical reactions in food 117
chicken. *See also* poultry
  types of 208
chloride
  function and sources of 246
choice grades 127-128
cholesterol
  defined 19
  level
    maintaining normal 31
chopping 155
chromium
  functions and sources of 247
chromosomes 264
citric acid 51
  as preservative 103
city health departments 295
climate
  and food supply 63
***Clostridium botulinum* 52, 95, 96, 104**
***Clostridium perfringens* 95, 96**
coagulation 133
coconut oil
  fat composition of 227
colanders 168
cold storage
  for food preservation 105
color
  as additive 49, 51
Color Additives Amendments 52
Commodity Food Distribution Program 72
commodity foods 72
common cold

  related to nutrition 16
communication 305
  defined 305
  needed for employment 305
complete egg substitute 200
complete proteins 238
complex carbohydrates 241
  defined 28
  foods with 29
compressed yeast 194
conduction 157
congealing point 228
Congregate Feeding Programs 24
connective tissue 203
consumer
  defined 53
  food prices and 5
contaminants
  environmental 94
  levels of 53
  microbial 94–95
contamination
  of food
    defined 93
convection 157
  oven
    defined 177
  oven cooking 177
convenience foods
  canned fish 208
cookery
  egg 201
  grain and pasta 217
  meat 203–206
  poultry 209–210
cooking methods 157
  braising 205
  broiling 205
  dry-heat cooking 174
  grilling 205
  in fat 205
  microwave cooking 42
  moist-heat cooking 174
  panbroiling 205
  roasting 204–205
  stewing 205
cooking process 155–156
  heat transfer 157
  methods 157
cooking times
  for frying 231
cooking utensils 161
cooperation
  defined 305
  needed for employment 305
Cooperative State Research Service 290
copper 163
  defined 163
  functions and sources of 247
corn oil
  fat composition of 227
corn syrup 51
cornstarch 218
corporation 307
cottonseed oil
  fat composition of 227
county general assistance 295
crops
  transportation and storage facilities 59
crude fat 258
crude fiber 258-259
crude protein 259
crusts
  types of 220
culture
  defined 63–64
  food patterns related to 63–64
curing
  and food processing 115
  for food preservation 105
customs
  and food 60, 65
cutting 154–155
cutting boards 168
cyanocobalamin 214. *See also* vitamin B_{12}
  defined 245
cytogenetics 264

D

deep-fat frying 205, 207, 208, 215
  fats and temperatures used 230
degradation 39-40
dehydrated foods 140
dehydration 43
  as preservative 105
  defined 43, 140
Delaney Clause 52, 123
demand
  and supply 5–6
developed countries
  defined 3
  food production of 58
  list of 272
developing countries
  defined 3, 272
  diets in 58
  farmers in 59
  food production of 58
    transportation and storage facilities 59
  illiteracy in 60
  list of 272
  political climate in 59
  poverty in 59
dextrins 133
diabetes 28-29
dicing 155
diet
  during pregnancy 33–37
  hypertension in 31–32
  low-fat 30–31
  milk intolerance in 32–33
  needs during pregnancy 33–35
  reducing sugar in 28–29
  sodium in 31–32
  special needs 27
dietary fiber
  functions of 29–30
Dietary Guidelines for Americans 17
dietary mainstays 3
dietetic technician
  preparation requirements of 303
dietetics
  careers in 301
dietitian
  preparation requirements of 303
direct marketing advertising 276
direct store delivery (DSD) 273
disaccharides 240
disasters
  and the food supply 63
disease
  and nutrition 264, 267
  cardiovascular 16–18
distress 309
diverticulosis 29
double-action baking powders

193
dough conditioner 49, 51
dough hook 153
doughs 188
dressed fish 206
dressed poultry 209
dried eggs 200
dried legumes 210
drop batters 188
drum drying 106
dry measuring cups 165
dry storage 178–181
dry-heat cooking methods 174
drying
  and food processing 115
  as preservative 105
  for food preservation 105–106
duck 128

E

Easter Seal Society 295
eating disorders 20–22
  anorexia nervosa 20–21
  bulimia 21–22
ecological factors
  and food supply 62–63
  defined 62
economics
  agencies related to 288
  and the food chain 2–3
  and the world food supply 1–2
Economics Research Service (ERS) 288
Egg Products Inspection Act 124
eggs
  albumen 200
  bloom 200
  candling 200
  chalaza 200
  cookery of 201
  cookery of protein 200–202
  Egg Products Inspection Act 124
  forms of 200
    complete egg substitute 200
    dried 200
    fortified 200
    fresh 200
    frozen 200
    partial egg substitute 200
  grades of 129–130
  ingredient in baked goods 191
  nutrient contents of 201
  storage of 180, 202
  white
    nutrients in 201
  yolk
    nutrients in 200
electrolytes 31
employee incentives 311–312
employment
  opportunities 300
  personal characteristics needed for 303–306
empty calories 236
emulsifier 49, 51
enamelware 163
enrichment 123
  defined 84, 236
  grains and pasta 242
entrepreneur 306-307
entrepreneurship 306–308
entry-level positions
  careers in 301
environmental contaminants 94
Environmental Protection Agency (EPA) 125
enzyme
  in nutrient loss 40
  technology for food preservation 107
essential amino acids 238
evaluation methods
  for food products 130–135
Expanded Nutrition Program 72-73, 292
Export Marketing Service 282
exports 124
  U.S. 282
  world food 280–281
Extension Service 290
extracts 131
extrusion 108

F

Fair Packaging and Labeling Act 123
  defined 52
famine 63
farm yields 61
Farmers Home Administration 290
farmer's markets 7
fat-soluble vitamins 243
fats 19–20, 245
  absorption of 230–231
  and frying food 229–231
  butter 228
  classifications of 226
  composition of 227
  cooking times for 231
  crude 258
  defined 19–20, 30, 225
  figuring percentage in diet 30
  hydrogenated 228, 228–229
  ingredient in baked goods 190
  lard 227
  margarine 229
  monounsaturated 226
  oils 228
  polyunsaturated 31, 226
  saturated 20, 31, 226
  servings from food group 236
  smoke points of 229–230
  used in food preparation 227–229
fatty acids 245
FDA. *See also* Food and Drug Administration
  regulation of food and drug industries 53
  regulations 54
Federal Crop Insurance Corporation 290
federal feeding programs 7
Federal Food, Drug, and Cosmetic Act 122–123
Federal Grain Inspection Service 127, 289
Federal Trade Commission (FTC) 6, 125
fermentation
  and food processing 115
  defined 106, 133
  method of food preservation 106
fiber 241
  crude 258–259
  defined 29
  dietary 29–30
  functions of 29–30
  insoluble 241

  soluble 241
field pea 210
FIFO 144-145
fill-of-container 130
fillets 206
finfish
  cookery of 206–207
fish
  convenience products 208
  cookery
    finfish 206–207
  cookery of protein 206–208
  fat 207
  finfish 206–207
  forms of 206
  lean 207
  microwave cooking of 208
  shellfish
    cookery of 207–208
fish steaks 206
flat beater 153
flavor 49, 51
  defined 228
  enhancer 49, 51
floor model mixer 153
flour
  ingredient in baked goods 188
fluffy cellulose 84
fluidity 132
fluoride
  functions and sources of 247
folate 214
  defined 244
  needs during pregnancy 35
food 121
  changes in during processing 114
  contamination of 93–95
  cookery of
    and altitude 181
  cooperative 8
  costs
    reducing 8
  customs related to 65
  embargoes 7
  evaluation of 257–258
  fabrication 82-83
    defined 82
  industry 4
  in space 116
  packaging
    advances in 254-255
    choosing 108
  patterns
    cultural 63-64
    societal 63-64
  prices 5
  raw 139–140
  reducing costs of 8
  religious customs and 64
  reserves 61
  sources
    alternative 7
  standards of content and quality 126–138
  storage of
    dry 178–181
    freezing 177–178
    refrigeration 178
  testing of 257–258
  transportation and storage facilities 59
  United States Trade 77
  world supply of 57–64
  world trade policies 77
food additives. *See also* additives
  common 50, 51
  defined 48
  functions of 48
  incidental 50
  intentional 48, 49
  regulation of 50–53
  safety of 52
Food Additives Amendment 123
  defined 50
Food and Agriculture Organization 70
Food and Consumer Services 288
Food and Drug Administration (FDA) 6, 125, 292
  defined 292
Food and Nutrition Service 6, 288
Food Assistance Organizations in the United States 71–73
Food Assistance Programs in Other Countries 73
food brokers 88, 274
food chain 1–3
  defined 1–2
  economics and 2–3
Food, Drug, and Cosmetic Act 50
Food for Peace 73
food groups 14. *See also* basic food groups and food guide
food guide 236
  for expectant mothers 35
food preparation
  careers in 301
food processing
  affect on food quality 113–116
  chemical reactions during 116–119
  defined 101
  methods 101–109
    effects of 115
food processors 153
food product evaluation 146
food production
  increasing 58
food production
  and distribution system
    defined 271
Food Production and Processing 83–85
food products
  laboratory evaluation methods for 130–135
  methods of heating 174–177
  regulating agencies 121–126
Food Safety and Inspection Service 289
food science
  careers in 301
  current issues in 267
  and nutrition
    careers in 300–303, 301
food science technicians
  preparation requirements of 303
food scientist
  preparation requirements of 302–303
food service industry
  new products for 255
Food Stamp Program 71–72
food supply 61
  ecological factors affecting 62–63
  social factors affecting 63–64
  technological factors affecting 60–62
food system 4
food technology 4–5
  advances in 253–257
  defined 81, 271
food web 2

food wholesalers 88
food-borne infection 95
food-borne intoxication 95
Foreign Agricultural Service 289
  defined 282
foreign commerce 121-122
Forest Services 290
formulated foods 84
fortification 123
  defined 84, 237
fortified eggs 200
franchise 307
franchisee 307
franchiser 307
free enterprise 306-307
freelance work 302
freeze-drying 43
  defined 43
  method of food preservation 106
freezing 177–178
  and food processing 115
  defined 144
  methods of 145
freezing point 132
French knife 167
fresh eggs 200
fringe benefits 310
frozen eggs 200
Frozen Food Roundtable 144
frozen foods 144–146
  storage of 181
fructose 51
fruit
  cookery of 213–215
  servings from food group 236
  storage of 180
fryer 208
frying
  time and temperatures for 231
  with fats 229–231

G

garden pea 210
gelatin 51
gelatinization 133, 217
General Agreement on Tariffs and Trade (GATT) 77
general partnership 307
genes 264
genetic engineering 62, 264
  defined 62, 256
  research using 267
glass 163
  for packaging 109
  opaque 163
glass-ceramic 163
glucose 51
  defined 28
gluten 151–152
  defined 188
goal 308
GOBI 76
goose 128
gourmet boutique 88
government agencies. *See also* agencies
  Cooperative Extension Service 6
  FDA 6
  food and nutrition service 6
  FTC 6
  USDA 6
grading 123
grains 215–219
  cookery of 217
  defined 215
  and pastas
    carbohydrates in 242
GRAS list 52
grater 166
green revolution 61
grilling 176
  defined 176
  dry-heat cooking method 205
grinding 204
guinea fowl 128

H

HACCP system 95–96, 97. *See also* Hazardous Analysis Critical Control Point (HACCP)
hand mixing
  batter method 153
  kneading 152
  sponge-dough method 153
  straight-dough method 152–153
hand-held mixer 153
Hazardous Analysis Critical Control Point (HACCP)
  defined 95–96. *See also* HACCP system
head space 104
heart disease
  lifestyle changes that reduce the risk 19
  related to nutrition 16–20
heat
  and nutrient loss 41
heat sterilization
  and food processing 115
heat transfer 157
  conduction 157
  convection 157
  radiation 157
heating 174
hen 208
herbs 131
high-acid foods 142
high-density lipoproteins (HDL) 19
home economics occupations 300–302
homogenizing 107-108
honesty 305
hot spots 162
human
  and animal studies 265–266
human nutrition
  careers in 301
Human Nutrition Information Service 288
humectant 49
  defined 116
hunger
  and lack of income 59
  and political climate 59
  defined 58
  facts 75
  world problem 73
hybrids 256
hydrogenated fat
  used in food preparation 228–229
hydrogenation 133, 228
hydrolysis 133
hydroponically 257
hypermarkets 88
hypertension
  and sodium in the diet 31–32
  defined 32

I

- **illiteracy**
  - and hunger 60
  - and poverty 60
- **imports 124**
  - U.S. 279, 282
- **Incaparina 84**
- **incentive 310**
- **incidental food additives 50**
- **incomplete proteins 238**
- **Industrial advertising 276**
- **ingredients**
  - characteristics of 188
  - eggs 191
  - fat 190
  - flour 188
  - in baked goods 187–192
  - leavening agents 190
  - liquid 190
  - salt 190
  - sugar 191–192
- **initiative 304**
- **injera 189**
- **insoluble fiber 241**
- **intentional food additives 49**
  - defined 48
- **intermediate moisture foods (IMF) 116**
- **International Affairs and Commodity Programs 288–289**
- **International Organizations 70–73**
- **interstate commerce 121–122**
- **intrastate 122**
- **iodine**
  - deficiency 263
  - functions and sources of 247
- **iron**
  - functions and sources of 247
  - needs during pregnancy 35
  - values in various foods 114
- **irradiation**
  - and food processing 115
  - defined 106
  - for food preservation 106–107

K

- **Kenyon Amendment to the Wiley Act 122**
- **kitchen shears 166**
- **kneading 152**
- **knife sharpener 167-168**

L

- **labeling**
  - regulations for 53
- **lactase 33**
- **lactic acid 51**
- **lactose intolerance 32–33**
- **lamb 128**
  - defined 203
- **laminates 109**
- **land ownership 59**
- **lard**
  - defined 227
  - fat composition of 227
  - vegetable oil shortening
    - fat composition of 227
- **laws**
  - food 122–124
- **leaching 40**
- **leavening agents 49, 51, 190**
  - air 192
  - baking soda 192
  - chemical agents 192
  - defined 187
  - forms of 192–197
  - ingredient in baked goods 190
  - steam 192
  - yeast 194–197
- **legumes**
  - defined 210
  - dried 210
  - protein cookery of 210–211
- **less tender cuts 203**
- **Lev-O-Cal 83**
- **life cycle 22**
- **light**
  - and nutrient loss 40
- **lima beans 210**
- **limited partnership 307**
- **linoleic acid 30, 226**
- **lipids 16-18, 30, 225, 245**
- **lipoproteins**
  - defined 19
  - high-density 19
  - low-density 19
- **liquid**
  - ingredient in baked goods 190
- **liquid measuring cups 165**
- **Listeria monocytogenes 95, 96**
- **listeriosis 96**
- **loaf pans 166**
- **local advertising 276**
- **lot numbers 144-145**
- **low-acid foods 142**
- **low-density lipoproteins (LDL) 19**
- **low-fat diets 30–31**

M

- **macaroni 216-217**
- **macrominerals**
  - defined 245
  - list of 246
- **magnesium**
  - functions and sources of 246
- **Maillard reaction 133**
- **Making the Menu Fit the Family 15**
- **malnutrition 58**
- **management**
  - defined 308
  - practices and multiple roles 308–309
- **managing multiple roles 308**
- **manganese**
  - functions and sources of 247
- **manipulation 41**
  - and nutrient loss 41
  - defined 151
  - procedures
    - defined 41
- **marbling 203**
- **margarine**
  - fat composition of 227
  - in food preparation 229
- **marinade 161**
- **market research 274–278**
- **marketing 274–278**
  - cost of 278
  - creative techniques 88
  - defined 5, 88, 274
  - farm products 61
  - new trends 88
  - sample survey results 277
- **Marketing and Inspection Services 289**
- **materials for utensils**

- aluminum 162–163
- cast iron 162
- characteristics of 161–164
- clear glass 163
- copper 163
- enamelware 163
- glass-ceramic 163
- nonstick finishes 164
- plastic 163
- stainless steel 163

maturing agent 49
matzo 189
mayonnaise
- standard of identity for 126

McNary-Napes Amendment to the Wiley Act 122
Meals on Wheels 24
measuring spoons 165
meat
- analogues 84-85
- bone 203
- connective tissue 203
- cookery 203–206
- cooking stages of 204
- cuts of 203
  - less tender cuts 203
  - tender cuts 203
- grades 128
- marbling 203
- microwave cooking of 205–206
- muscle 203
- protein cookery of 203–206
- servings from food group 236
- standards of quality for 127–128
- storage of 179
- types of
  - beef 203
  - lamb 203
  - mutton 203
  - pork 203
  - variety meats 203
  - veal 203

Meat Inspection Act 122
mechanical mixing 153–154
- cake method 154
- defined 153
- sweet yeast breads 154

melting point 132, 228
metal
- for packaging 109

microbes 43, 135
microbial contaminants 94–95
microminerals
- defined 245
- list of 247

microorganisms 94, 102
microwave cooking 42–43, 176–177, 218
- defined 42
- of carbohydrates 218
- of cheese 212
- of fish 208
- of fruits and vegetables 213
- of meats 205–206

microwaves 176
milk 128–130, 212
- allergy 32
- cookery of 212
- grades of 128
- intolerance 32-33
- servings from food group 236
- storage of 180
- types of 129

Miller Pesticide Amendment 123
minerals 245
- defined 243

minimum wage 310
misbranded foods 257–258
- defined 54

mixer 153
mixing 151–154
- beating 154
- defined 151
- hand 152–153
- mechanical 153–154

modified atmosphere
- for food preservation 107

modified starches
- defined 219
- food starches 51

moist-heat cooking 157
- methods 205
  - defined 174

moisture 259
molds
- Penicillium 94
- defined 95
- in fermentation 106

money management 310
monoglycerides 51
monosaccharides 240
monosodium glutamate 131
- *See also* MSG

monounsaturated fats 227
- defined 20, 226

MSG 51. *See also* monosodium glutamate
- defined 131

muffin method 152
muffin pans 166
multiple roles
- management of 308–309

muscle 203
mutton 128
- defined 203

N

national advertising 276
National Agricultural Library 291
National Agricultural Statistics Service 288
National Marine Fishery Service 125
need 308
new countries 272
New Products for Convenience 87
new products for the food service industry 255
new products for the health conscious consumer 86–87
niacin 214. *See also* vitamin B_3
- deficiency 263
- defined 244
- values in various foods 114

nonessential amino acids 238
nonstick finishes 164
noodles 217
nutrient density 34, 236
nutrient loss
- causes 39–41
  - alkalinity and acidity 41
  - enzymes 40
  - heat 41
  - leaching 40
  - light 40
  - manipulation 41
  - oxidation 39–40

nutrients 49, 51
- chemical reactions in food 117
- preservation techniques
- retention
  - new technology in 42-43

  - six basic groups 235
  - values in various foods 114
- **nutrification 236–237**
- **nutrition**
  - and aging 22–23
  - and disease 264, 267
  - and pregnancy 33–35
  - and world progress 73–77
  - education about 58
  - for older adults 23–24
  - meeting needs of the world 57
  - preventive 16
  - related to cancer 16
  - related to common cold 16
  - related to heart disease 16–20
  - requirements during life cycle 22
  - research in 263

O

- **Office of Advocacy and Enterprise 291**
- **Office of Budget and Program Analysis 291**
- **Office of Consumer Advisor 288**
- **Office of Energy 288**
- **Office of Finance and Management 291**
- **Office of Information Resources Management 291**
- **Office of Inspector General 291**
- **Office of International Cooperation and Development 289**
- **Office of Operations 291**
- **Office of Personnel 291**
- **Office of the General Counsel 291**
- **Office of Transportation 289**
- **oils**
  - defined 30, 225
  - used in food preparation 228
- **Olestra 84**
- **olive oil**
  - fat composition of 227
- **opaque glass 163**
- **oral rehydration therapy (ORT) 76**
- **organoleptic properties 102**
- **origin of food 1**
- **osteoporosis 33**
- **overnutrition 58**
- **oxidation 39–40**
  - chemical reactions in food 117
  - defined 40, 135

P

- **packaging 85**
  - materials
    - glass 106, 109–111
    - metal 109
    - paper 109
    - plastic 110
  - role in food processing 108–111
- **Packers and Stockyards Administration 289**
- **palatable 41**
- **palm oil**
  - fat composition of 227
- **pan-frying 205**
- **panbroiling 205**
- **pantothenic acid 214**
  - defined 244
- **papain 203-204**
- **paper**
  - as packaging material 109
- **paprika 51**
- **paring knife 167**
- **partial egg substitute 200**
- **pasta 215–219**
  - cookery of 217
  - defined 216–217
  - enrichment of 242
  - types of 216
- **pasteurization**
  - defined 107
  - for food preservation 107
- **Pasteurized Milk Ordinance 123**
- **pastry blade 153**
- **pastry method 152**
- **Pattern for Daily Food Choices 14**
- **peanut oil**
  - fat composition of 227
- **pectin 51**
- **pemmican 116**
- **per capita income 58**
- **perfringens poisoning 96**
- **perishable**
  - defined 139
  - foods 39
- **personal appearance 305–306**
- **personal characteristics**
  - needed for employment 303–306
- **pesticide chemicals 53**
- **pH control agent 49, 51**
- **pH level**
  - defined 41, 102, 142
  - of common foods 104
- **phenylketonuria (PKU) 83**
- **phosphate baking powder 193**
- **phosphoric acid 51**
- **phosphorus**
  - functions and sources of 246
  - values in various foods 114
- **phylloquinone 214, 244.** *See also* vitamin K
- **physical modification 107**
- **physical properties 130–132**
- **pie pans 166**
- **pies and pastries**
  - cooking 221
- **pita bread 189**
- **plant and soil science studies 264–265**
- **plaques 16-18**
- **plastic**
  - as packaging material 110
  - utensils 163
- **plasticity 132**
- **poaching 207**
- **political climate**
  - and hunger 59
- **polyculture 256**
- **polymerization 110**
- **polysaccharides 240-241**
- **polyunsaturated fats 227**
  - defined 226
  - foods containing 31
- **pork**
  - cooking of 204
  - defined 203
  - grades of 128
- **positive attitude**
  - defined 304
  - needed for employment 304
- **postharvest technology 58**
- **potassium**

  - functions and sources of 246
  - values in various foods 114
- **potassium sorbate 51**
- **potato starch 218**
- **poultry 208–210.** *See also* chicken
  - cooking of 209–210
  - defined 208
  - grades of 128
  - standards of quality for 128
  - storage of 179
- **Poultry Products Inspection Act 123**
- **pounding 204**
- **pour batters 188**
- **poverty 59**
  - and hunger 59
  - defined 69
- **pregnancy**
  - dietary needs during 33–37
  - food guide for pregnant mother 35
- **preparation methods 107–108**
- **preservative 49, 51**
- **preserving food**
  - defined 101
  - methods 102-107
- **Presidential Commission on World Hunger 76**
- **pressure cooking 175**
- **preventive nutrition 16**
- **prime grades 127-128**
- **prior-sanctioned substances 50-52**
- **priorities 308**
- **processing.** *See also* food processing
  - defined 5
  - methods of 101–109
- **product development 85–87**
- **production**
  - defined 5
  - world food 58
- **professional advertising 276**
- **professional publications**
  - of nutrition agencies 294
- **professionalism 306, 306–308**
  - defined 306
- **propionic acid 103**
- **protein**
  - cookery of
    - cheese 211–212
    - fish 206–208
    - legumes 210–211
    - meat 203
    - milk 212
    - poultry 208–210
  - crude 259
- **proteins 237–240**
- **proximate analysis 258**
- **pulse-combustion drying 106**
- **Pure Food and Drug Act 122**
- **pyridoxine 214.** *See also* vitamin B_6
  - defined 244

Q

- **quality 127-128**
- **quality control 96**
- **quick breads 187**
- **quick-freezing 43**

R

- **radiation 157**
- **rancidity**
  - defined 133
  - rate of 228
- **raw foods 139–140**
- **recalls 125**
- **recombinant DNA 256**
- **refrigeration 178**
  - and food processing 115
  - defined 105
- **religion**
  - beliefs and food 60
  - customs and food 64
- **research**
  - current issues 267
  - market
    - tools 276
  - on animals and humans 265
- **research**
  - methods 264–266
  - tools 276
- **resource 287**
- **restoration 237**
- **retail outlets 88**
- **retinol 214, 243.** *See also* vitamin A
- **retorts 104**
- **riboflavin 214.** *See also* vitamin B_2
  - defined 244
  - values in various foods 114
- **rice**
  - cookery of 217
- **roaster**
  - defined 208
  - hens 209
  - toms 209
- **roasting**
  - dry-heat cooking method 204–205
- **rolling pins 168**
- **round 194**
- **Rural Electrification Administration (REA) 290**

S

- **saccharin 51**
- **safflower oil**
  - fat composition of 227
- **salaries 310**
- ***Salmonella* 95, 96**
  - illustration of 94
- **salmonellosis 96**
- **salt 190**
  - defined 135
  - ingredient in baked goods 190
  - for food preservation 103
- **saturated fats 227**
  - defined 20, 226
  - foods containing 31
- **saturated solution 132**
- **saucepans 166**
- **sautéing 207, 208, 213, 215**
- **scale 194**
- **School Breakfast Program 72**
- **School Lunch Program 72**
- **science and education 290–291**
- **scoring 204**
- **seafood 62**
  - storage of 179
- **Seafood Inspection Amendment to the Wiley Act 122**
- **seasoning 162**
- **select grade 127-128**
- **selenium**
  - functions and sources of 247
- **self-control**

  defined 304
  needed for employment 304
separation
  method of food processing 108
shallow roasting pans 166
shape 194
sharpening steel 167
shelf life 140, 178-179
shellfish
  cookery of 207–208
silent partners 307
simple carbohydrates 241
  defined 28
  foods 29
Simplesse 83-84
single-action baking powders 193
skilled workers 301
skillets 165
slicer knife 167
slicing 155
Small Community and Rural Development 290
smoke
  as a food preservative 103
smoke point
  defined 228
  of fats 229–230
social factors
  and food supply 63–64
society 63-64
sodium
  and hypertension 31–32
  foods high in 32
  functions and sources of 246
sodium acetate 51
sodium aluminum sulfate 193
sodium benzoates
  as preservative 103
sodium bicarbonate 51
sodium nitrate 51
sodium nitrite 51
  as preservative 103
soil
  and food supply 63
Soil Conservation Service 290
sole proprietorship 307
solubility 132
soluble fiber 241
sorbic acid 51
  as preservative 103
soy concentrate 239
soybean oil
  fat composition of 227
space
  food in 116
spatulas 168
spices 131
sponge-dough method 153
spray drying 106
squab 128
stabilizer 49, 51
stainless steel 163
standard of quality
  eggs 129
  milk 128–130
  poultry 128
standards 308
standards of identity 126–127, 258
  defined 7, 126
  for mayonnaise 126
standards of quality 127–130
  defined 127
  for meat 127–128
staph 96
Staphylococcus aureus 95, 96
starch
  as thickener 218–219
    cornstarch 218–219
    modified starches 218
    potato starch 218–219
    tapioca 218
  defined 215
steam
  leavening agent 192
steam-pressure method 105
steaming 174–175, 207
  defined 174
  pressure cooking 175
  vegetables 213
sterilizing agent
  for food preservation 103
stevioside 83
stewing
  moist-heat cooking method 205
  seafood and chicken 208
stewing hens 208
stir-frying 43, 175
  defined 43, 175
  with fat 205
storage
  of food 177–181
    dry 178–181
    freezing 177
    refrigeration 178
    containers 168
  facilities and transportation 59
straight-dough method 152-153
stress 309–310
string bean 210–211
studies
  human and animal 265–266
  plant and soil science 264–265
sublimation 106
sugar
  ingredient in baked goods 191
  reducing intake of 28–29
  terms used on food labels 28
sugar and smoke
  for food preservation 103
sun drying 106
sunflower oil
  fat composition of 227
superstitions
  and food 60
supply
  and demand 5–6
  defined 5–6
surimi 82
sweet butter 228
sweet yeast breads 154
  defined 195
sweetener 49, 51
synthetic
  additives 52
  defined 85, 116–117
  foods 274

T

table model mixer 153
tapioca 219
tartrate baking powder 193
technological factors
  affecting food supply
  agricultural capabilities 60
  and food supply 60
technology
  and availability of foods 271–274
  and food and nutrition 271–285
  defined 81
  food processing and marketing 81–85

temperate regions 5
temperature
  chemical reactions in food 117
tender cuts 203
tenure relationships 59
Texas Agricultural Extension Service 291–292
Texas Department of Health 292–293
Texas Department of Human Services 293
texturized vegetable protein 83
texturizer 49, 51
thermal modification 108
thermal processing regulations 53
thiamin 214. *See also* vitamin B_1
  defined 244
  values in various foods 114
thickener 49, 51
Title III Nutrition Program for the Elderly 72
tofu 85
tongs 166
tortillas 189
toxic substance 52
trace elements 245
trade 57
trade advertising 276
transportation 282
tray drying 106
trichinosis
  and pork 204
triglycerides 20
tunnel drying 106
turkey 128, 208. *See also* poultry
  broiler 209
  roaster hen 209
  roaster tom 209
  types of 208

U

U.S. federal food programs 71
U.S. RDA 16
undernutrition 58
United Nation's Children's Fund (UNICEF) 75–76
United States Department of Agriculture (USDA) 125, 288-292. *See also* USDA
  defined 6
United States Department of Health and Human Services 292–293
United States Exports and Imports 282
United States Public Health Service 126
UPC Universal Product Code 273
USDA. *See also* United States Department of Agriculture
  inspections 122
utensils
  cooking and baking 161–168
  defined 161
  materials 161–164

V

value systems 59
values 308
vanilla 51
variety meats 203
veal 128
  cooking 204
  defined 203
vegetable oil 228
vegetable peeler 166
vegetables
  cookery 213–215
  servings from food group 236
  storage of 180
vegetarianism 238
Veri-Green process 89
virus 94
  defined 95
vitamin A 214
  defined 243. *See also* retinol
vitamin B_1 214. *See also* thiamin
  defined 244
vitamin B_{12} 214, 245. *See also* cyanocobalamin
vitamin B_2 214. *See also* riboflavin
vitamin B_3 214. *See also* niacin
vitamin B_6 214, 244. *See also* pyridoxine
vitamin C 51, 134, 147, 214. *See also* ascorbic acid
  deficiency 263
  defined 244
  values in various foods 114
vitamin D 214. *See also* calciferol
  deficiency 263
  defined 243
vitamin E 214. *See also* alpha tocopherol
  defined 244
vitamin K 214. *See also* phylloquinone
  defined 244
vitamins 243–245
  cookery of in fruits and vegetables 213–215
  defined 243-245
  functions, names, sources of 214, 243-245

W

want 308
warehouse shopping 88
water
  activity 116
  chemical reactions in food 117
  functions and sources of 248
water-soluble vitamins
  defined 243
  retaining 156
Weight and Measure Amendment to the Wiley Act 122
WHO. *See also* World Health Organization
  program goals 71
whole fish 206
wholesalers 274
Wholesome Poultry Products Act 123
Wiley Act 122. *See also* Pure Food and Drug Act
wire whip 153
wok 175
Women, Infants, and Children (WIC) Supplemental Food Program 72, 293
world

  food distribution 278–282
  food exports 280-281
  food supply 57–64
  food trade policies 77
  hunger problem 73
    solutions 73–76
  nutritional needs of 57–60
World Agricultural Outlook Board 288
World Food Program
  defined 73
  economics and 1–2
World Health Organization (WHO) 70. *See also* WHO

Y

yeast 94
  active dry 194
  as a leavening agent 194–197
  breads 188
  compressed 194
  defined 95
  sweet yeast breads 195
  used in fermentation 106
yield 127-128
yolk
  defined 200
  nutrients in 201

Z

zinc
  functions and sources of 247